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APPALACHIAN FOREST EXPERIMENT STATION

Report for Calendar Year 1932 and First Half of 1933

Program for Fiscal Year Beginning July 1, 1933

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APPALACHIAN FOREST EXPERIMENT STATION

PERSONNEL, 1932

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L. I. Barrett	Associate Silviculturist
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Entomology

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APPALACHIAN FOREST RESEARCH COUNCIL

MEMBERSHIP IN 1933

W. D. Tyler, President
J. H. Pratt, Chairman of Executive Committee
E. H. Frothingham, Secretary

Georgia

T. G. Woolford, Retail Credit Company, Atlanta.

Kentucky

T. P. Cooper, Director, Kentucky Agr. Experiment Station, Lexington.
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North Carolina

G. A. Cardwell, Atlantic Coast Line Railway, Wilmington,
Andrew Gennett, President, Gennett Lumber Company, Asheville.
J. S. Holmes, State Forester, Raleigh.
J. H. Pratt, Consulting Engineer, Chapel Hill.
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South Carolina

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J. O. Hazard, State Forester, Nashville.
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Virginia

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Chapin Jones, Director of Education, State Forest Service, Charlottesville.
W. D. Tyler, Vice President, Clinchfield Coal Corporation, Dante.

West Virginia

T. H. Clagett, Chief Engineer, Pocahontas Coal and Coke Co., Bluefield.
John Raine, President, Meadow River Lumber Company, Rainelle.
B. L. Roberts, Cherry River Boom and Lumber Company, Richwood.

August 15, 1933.

T W E L F T H A N N U A L R E P O R T A N D P R O G R A M
A P P A L A C H I A N F O R E S T E X P E R I M E N T S T A T I O N
A S H E V I L L E, N. C.

Report for Calendar Year 1932 and First Half of 1933

Program for Fiscal Year Beginning July 1, 1933

This report summarizes the principal activities and accomplishments of the Appalachian Forest Experiment Station during the past year and a half and includes a program of work for the Fiscal Year 1934. Discussions of the objects, development, and past results of the various investigative projects are abbreviated or omitted. These can be found in previous annual reports of the Station, particularly that for 1931-32.

The program of work for the next Fiscal Year has had to be revised to conform to reduced funds and to changes in the outlook and possibilities for investigation caused by the E.C.W. Even at the date of writing it is more than usually difficult to foresee what part of the large amount of work that should be done can be best accomplished under the funds and facilities provided.

T E R R I T O R Y A N D F U N C T I O N S O F T H E S T A T I O N

The Station was established July 1, 1921, with headquarters at Asheville, N.C. Its purpose is to furnish authoritative information upon forest conditions and to solve problems of timber growing and forest land management in the Southern Appalachian Region from West Virginia to North Georgia and on the Atlantic Coastal Plain of Virginia, North and South Carolina. Investigations are now being conducted under two Forest Service appropriations, for studies in forest management (silviculture and forest fire protection) and in the relation of forest cover to streamflow and erosion. In addition, research in forest entomology, forest biology, and forest fire weather is being carried, under separate appropriations, by the Bureau of Entomology, the Biological Survey, and the Weather Bureau, respectively.

S U M M A R Y O F G E N E R A L A C T I V I T I E S

During the period covered by this report, Federal forest activities within the Station's territory have greatly increased. Development of the President's plans for Emergency Conservation Work, the Tennessee Valley Project, and the greatly enlarged program for National Forest Acquisition have placed a new and larger emphasis upon the need for basic information in Southern Appalachian forestry, and the Station has welcomed the opportunity to contribute to these emergency activities.

Up to the present, the principal contributions of this character, apart from the regular investigative work of the Station, have been: (1) assemblage of information upon many aspects of forest land ownership and management in the Station's territory, for use in the Copeland Report (published as "A National Plan for American Forestry," Senate Document 12, 72nd Congress); (2) preparation of the manuscript published as "Measures for Stand Improvement in Southern Appalachian Forests", Emergency Conservation Work, Forestry Publication No. 1; and (3) participation in the training of cultural foremen in emergency conservation work for the Pisgah, Cherokee, and Monongahela National Forests.

The publication "Measures for Stand Improvement in Southern Appalachian Forests" attempts to present as clearly as possible our present knowledge of the methods for bringing run-down or poorly productive forest stands into better condition for timber production and watershed and soil protection. All forest stands were more/less arbitrarily divided into seventeen condition classes, based on size of trees, condition of dominant canopy, degree of desirable stocking in the understory, and severity of competition in the understory. These condition classes have been arranged in tabular form with recommended methods for light and heavy treatments. In addition numerous tables and appendices present much information on forest conditions, forest types, and relative desirability and occurrence of species.

Working Centers

As the problems of silvicultural research in the Southern Appalachian Region have become more clearly defined, the need for extensive surveys, except for special purposes, has become less acute. There has been a natural transition from the reconnaissance type of investigation to the sample plot method, which will in turn be followed by a more formalized form of research through the use of specialized plots, and greenhouse and laboratory technique. Consequently a greater need has arisen for branch stations and experimental forests representing forest conditions typical of different parts of the region.

Four branch stations were being operated prior to 1932: Asheville, N.C., with an experimental forest at Bent Creek on the Pisgah National Forest; Berea, Ky., using the Berea College forest; Edinburg, Va., with a group of permanent plots on North Mountain, George Washington National Forest; and the northern extremity of Georgia, centering on the woodlands of the Georgia (State) Mountain Experiment Station and lands on the Cherokee National Forest.

At the Bent Creek experimental forest notable improvements were made under previous allotments for unemployment relief. A four-car garage, workshop, and a fourth laboratory unit were erected, and an interbuilding telephone line was installed. At Bent Creek, also, maps of the forest showing all sample plots, cuttings, plantings, experimental burns, improvements, etc., were prepared. These are in addition to the type and topographic maps prepared in 1930.

This experimental forest is receiving an increasing use as a demonstrational area. The excellent quarters provided, together with the variety of research under way have attracted large numbers of visitors, particularly forestry students and instructors en tour. During the year groups of students from North Carolina, Syracuse, Michigan, and Iowa have visited the area.

In 1932 and early 1933, additional experimental forests were established on the Monongahela National Forest, W. Va., and on the Cherokee National Forest, Ga. On the Monongahela National Forest, the boundaries of the 3,600 acre Elk Lick Run Watershed were surveyed, maps were prepared, and data were obtained for an inventory of the growing stock. This area has now been officially designated and set aside as the Farnow Experimental Forest. On the Cherokee National Forest, an area of 2,300 acres in the Mulky Creek Watershed was examined and a report submitted on the basis of which this forest was formally established as the Toccoa Experimental Forest.

A reconnaissance was made of the Pisgah and Nantahala National Forests for the purpose of locating additional experimental units. A tract of approximately 4,000 acres in the Ceweeta section of the Nantahala National Forest was recommended and is now awaiting official action.

Surveys and reports on two proposed natural areas were completed. The Black Mountain Natural Area in the Pisgah National Forest was recommended and has been set aside for the purpose of preserving a typical virgin forest of hardwood and red spruce. A second area, in the watershed of Singe Cat Creek, Pisgah National Forest, was surveyed but not recommended, chiefly because of its small size.

I N V E S T I G A T I V E P R O J E C T S

The central objective of all investigations by the Appalachian Station is to determine the kind of timberland management that will yield the highest permanent returns in timber production, watershed protection and erosion control, game and wild life conservation, and all other productive and protective functions that the forest should fulfill. In order to work systematically and without confusion on this large program, it is necessary to classify it into logical parts. Thus the three major divisions are silvicultural forest management, having to do with the production of commercial timber; streamflow and erosion studies; and the maintenance and interrelation of game and other wild life. These major divisions are themselves too large to be effectively studied without further subdivision. Thus the subject of silvicultural forest

management is split into subdivisions having to do with methods of cutting, thinnings and other cultural measures, protection from fire, protection from insects and disease, the growth of the forest, planting, and phenology, or the study of the periodicity of life processes of trees. Independent as these individual projects may appear to be, there are very definite threads of relation between them. Each must be considered in relation to all others in the general picture, and in most cases the correlations are both important and intricate, as in the case of silviculture and protection; game management, forest protection, and silviculture; streamflow relations and silviculture; forest protection and erosion, etc.

This interrelationship is influencing the development of the individual projects, the discussion of which follows:

FOREST MANAGEMENT

MANAGEMENT -- MOUNTAIN HARDWOOD FOREST

Purpose

The purpose of this project is to find practicable methods for increasing the productivity of forest lands which, for the most part, have suffered from indiscriminate logging, forest fire, and the chestnut blight. Specifically, the investigations are to determine (1) methods of logging which will result in ample reproduction of desirable species, (2) cultural methods for improving the composition and growth of young stands and of second growth, and (3) the reasons for the success or failure of desirable reproduction.

Past Work

The effectiveness of different methods of cutting to insure good re-stocking has in the past received considerable attention. However, results of extensive surveys have demonstrated that large parts of the areas which have been cut over would be adequately stocked provided the desirable reproduction could be freed of competition from the huge quantity of defective holdovers and undesirable second-growth and reproduction. One of the important problems has thus been defined. It remains to determine experimentally, by means of sample plots, the best methods of releasing this desirable reproduction; and also to give greater emphasis to the study of important factors influencing establishment and survival of this young tree growth.

To and including 1931, the Station had established 24 plots (19.6 acres) to study controlled cutting, 20 plots (6.6 acres) to study improvement of young reproduction, 21 plots (6.2 acres) to study thinnings in second-growth, and 10 plots (9.0 acres) to study the rate and kind of replacement of blight-killed chestnut by other species. In addition, two half-acre plots and 60 "milacre" quadrats were established for the study of factors responsible for the success or failure of desirable reproduction.

Current Progress

A 17.1 acre unit (b-3) of the Bent Creek experimental forest was cut over as the first treatment in an experiment in the conversion of a yellow pine-hardwood stand into pine standards with hardwood coppice. Three half-acre sample plots each with twenty half-milacre reproduction quadrats were established. A new scheme of mapping, rather than tagging, the seedlings on these quadrats was devised. Of 310 cords of wood cut from the area, 60 cords will be used at the laboratories and 250 cords were sold for \$1.50 a cord, of which 40 cents will be returned to the Station for additional work on the unit.

Another Bent Creek unit (a-3) was clear cut except for yellow poplar seed trees, and a half-acre sample plot with reproduction quadrats was established. On land adjacent to the Bent Creek experimental forest, 10 quadrats were established in a mixed stand of oaks and pine for the purpose of studying the effectiveness of removing understory vegetation and plowing the surface soil in obtaining a reproduction of pine. Quadrats on sample plot 25, Bent Creek, were reexamined, and establishment reports were written for plots 36 to 44, inclusive.

In North Georgia five quarter-acre sample plots were examined which had been established on Cooper's Creek, Cherokee National Forest, in 1931, to observe the reaction of white pine reproduction to a deadening of the hardwood overstory. Marked acceleration in the height growth of the white pine was noted, indicating its ability to compete successfully with hardwood reproduction and shrubs. Of the methods used in deadening - poisoning with sodium arsenite and axe girdling - the former was superior in reducing the number and size of sprouts.

A study of yellow poplar reproduction was initiated on the Bent Creek experimental forest to determine (1) the factors governing establishment, and (2) practical ways to obtain good seedling and seed-bed conditions for yellow poplar. In the spring 26 quarter-milacre quadrats were established at six locations, and weekly records were kept of the height, vigor, and dominance of each young poplar on the quadrats. Germination extended over a period of seven weeks - May 10 to June 23. Practically none of the 1932 stems reached a height of over 0.1 foot, and about half of them were missing in the spring of 1933. Seedlings that germinated in 1931 reached heights of 0.2 to 0.4 feet in 1932, and by the middle of May, 1933, had grown to heights of 0.4 to 1.0 feet.

Another experiment designed to test the success of yellow poplar germination and early survival was begun in the woodlands of the Georgia Mountain (State) Experiment Station. Thirty-two screened quadrats were established by the Latin Square method under seed bed conditions which might easily be duplicated by labor crews in the woods. The seed bed conditions provided were (1) removal of litter and soil scarification with Council fire tools, (2) removal of leaf litter by burning, (3) sowing of seed on leaf litter followed by raking seed well into the litter, and (4) controls on which seed were sowed directly on the litter. Thus far, germination on quadrats has been very much lower

than that determined by the greenhouse test, indicating that possibly a high proportion of the seed sown in the field will not germinate until the second season.

At the North Georgia Mountain (State) Experiment Station examinations were made of three white pine plantations established by the Appalachian Station in November, 1931, and of oriental chestnuts put in in March of the same year by the Bureau of Plant Industry. Of the white pine planted on eroding old fields, grade 2 stock showed much higher mortality than grade 1. A planting of grade 3 stock under scattering hardwoods showed the highest mortality, the chief cause of which was apparently the covering of the small pine seedlings by hardwood leaf litter. In the oriental chestnut plantation mortality had increased from seven percent in the spring of 1931 to 19 percent at the end of the 1932 growing season, and no significant increase in growth had taken place between the two examinations. The lack of vigor is doubtless due to a twig blight which is affecting a large proportion of the seedlings, although the chestnut blight itself has infected only a very few.

1933 Plans

The timber stand improvement, started on the national forests in May and June by the Civilian Conservation Corps, follows, on a large and non-experimental scale, some of the forms of silvicultural treatment that are being studied experimentally by the Appalachian Station. In fact, the instructions for this work were formulated by the Station, in cooperation with the eastern Regional administrative office of the Forest Service. Since all the silvicultural improvement work now under way on a large scale is within the field that is being or is to be covered experimentally by the Station under this forest management project, an unusual opportunity is presented for collecting data of extreme value for present as well as future investigations. To take advantage of this opportunity it will not be necessary for the Station to change its project line-up, although the field of study might be extended to condition classes not hitherto investigated.

A plan has accordingly been prepared by which the Station can make as full use as possible of E. C. W. opportunities for experiments in cleanings, liberation cuttings, and thinnings. It is proposed to install permanent sample plots, with check plots, to find out how successful the crop-tree method of minimum cleaning may be under different conditions; most satisfactory spacing of crop-trees; reaction of different species to girdling; feasibility of cutting back indifferent or poor crop trees to produce seedling sprouts; growth-rate and competitive vigor of crop trees of different species; the laurel and rhododendron problem; relative advantages of complete and incomplete severance in cleaning; and other problems. Many of these questions will not require special plots but may be studied simultaneously on a single series of plots established in different forest types, sites, and conditions. The chief difficulty will be the Station's very limited funds for field work.

In addition to the special E. C. W. forest management research plan, the Station has completely revised the general management research working plan. According to the present schedule, sample plots at Bent Creek, Mons, Cranberry, Lookingglass Rock, Biltmore Estate, Berea, and North Georgia, are in need of remeasurement.

MANAGEMENT -- COASTAL PINE FOREST

Purpose

The rapid tree-growth, large timbered area, ease of logging, and accessibility of the Mid-Atlantic Coastal Plain to manufacturing and consuming centers are advantages that contain great promise for profitable timber growing. Timber growing for profit, however, must be technically well-founded on thorough knowledge of the many factors that affect it. The purpose of this project is to acquire such a knowledge for the growing, particularly of loblolly pine. It embraces the study of growth, reproduction, and management of loblolly and other pines. Investigations fall into four subdivisions: (1) best methods of harvesting timber crops to insure ample and desirable reproduction; (2) methods of improving the quality and growth rate of young-growth and second-growth stands; (3) determination of the growth-rate of stands differing in density and composition, and of individual trees growing under different conditions; and (4) determination of factors affecting establishment, survival, and early development of reproduction.

Past work

As in the case of the management project for the mountains, the Coastal Plain studies also have an extensive survey and a permanent sample plot phase, with a place for fundamental studies to determine causative factors. In the extensive survey phase 89 acres of chain-wide strip and 9 acres of reproduction strip have been run on burned and unburned cut-over loblolly pine lands, yielding data on the extent and nature of reproduction; but further work of the kind is necessary. In the permanent sample plot phase 14 plots (22 acres) have been established to study the results of selective logging (and also to analyze costs and returns from logging trees of different diameters, conducted by the Forest Products Laboratory in cooperation with the Station); and 8 plots (2 acres) to study the effects of thinning longleaf and loblolly stands. To determine the growth rate of loblolly pine trees left after cutting, measurements were made of growth at breast height of 1,500 trees on areas cut over 12 to 17 years previously and of the distribution of increased growth along the bole on 80 trees.

Progress on this project has been handicapped by lack of funds and of experimental areas under complete control. The funds available have permitted only the full time of one man with very little assistance. Attempts to obtain an experimental forest thoroughly representative of good growing conditions for loblolly pine have so far been unsuccessful. It is hoped that with the purchase of national forest land, which is now proceeding in South Carolina, such an area may be found.

Current Progress

The largest proportion of time spent on this study during the past year was utilized in the compilation and analysis of the data taken during 1930 on the increase in growth of loblolly pines left following partial cutting. The part of this study dealing with increase in growth at breast height was completed. The analysis of these data indicates that most loblolly pines left

after partial cutting do increase in rate of growth at breast height and that small, tall trees with wide, long crowns show the greatest increase. Equations and alignment charts were prepared by which can be predicted the growth of loblolly pine trees left after partial cutting to a 10 inch diameter limit in stands 45 to 60 years old, growing on areas with site indices between 80 and 90 and between .5 and .8 stocked.

The reproduction quadrats on the Franklin, Va., methods of cutting plots were reexamined. A rough survey of the data shows a great preponderance of hardwood reproduction, which in turn indicates the probable future need for cultural operations on the plots, if the next stand is to contain a predominance of loblolly pine.

The felled, poisoned, and girdled hardwoods on some of the Franklin, Va., plots were reexamined. The data have not been compiled but it is quite plain that poisoning has materially retarded sprouting.

Data obtained on the damage done to standing trees during the logging of the Franklin, Va., forest-grown stand and the Windsor, N. C., old-field stand are summarized in the following tabulation. It appears that many more pines than hardwoods were damaged in logging.

Summary of Logging Damage to Expected Residual Stands

Class of damage	Forest-grown				Old-field			
	No. of trees per acre		Percent of residual stand 1/		No. of trees per acre		Percent of residual stand 1/	
	Loblolly pine	Hdwds	Loblolly pine	Hdwds	Loblolly pine	Hdwds	Loblolly pine	Hdwds
1. Damaged beyond recovery	4.8	12.5	6.8	6.3	7.8	5.5	7.0	4.1
2. Removed incident to logging	0.9	26.2	1.2	12.9	1.5	17.0	1.3	12.7
3. Injured slightly	2.8	32.5	4.0	16.0	11.5	30.2	10.3	22.5

1/ Percentages computed on basis of expected residual stand in separate species groups.

The data on the Hanover County, Va., thinning plots were analyzed. During the first period, between 1913 and 1919, the plot from which 20.1 percent of the volume was removed in thinning showed 56.5 percent greater growth than the unthinned plot, while the plot from which 7.9 percent of the volume was removed in thinning showed 69.9 percent greater growth than the check plot, on which no thinning was done. The growth data for the period 1919-1930 gave no results of value because an insect infestation on the plots overshadowed the effects of thinning. At present the plots offer little promise for further thinning studies. Also they appear to have very limited value for studies of rate of return to normality of insect damaged stands because the thinning practiced on the plots prior to the insect infestations materially changed the stand distributions. Since it would cost nearly as much to rehabilitate the plots as it would to establish new plots which would be much more representative of conditions encountered in field practice, it is recommended that the plots be abandoned.

1933 Plans

Active extension of the investigations in methods of cutting, growth, and treatment of young and maturing stands rests upon the outcome of efforts to obtain an experimental forest tract on new and proposed national forests on the Coastal Plain. If these efforts are successful, as now appears likely, it is proposed to use E. C. W. men in the establishment of much needed permanent plots.

Other work planned for 1933 includes: (1) reexamination of the Franklin, Va., permanent sample plots which suffered an accidental fire during March 1933; (2) reexamination of the reproduction quadrats on the Windsor, N.C., permanent sample plots; (3) subdivision of each permanent sample plot at Windsor, N. C., followed by the removal of all hardwood sprouts from one-half of each plot. This work will also include the establishment of special reproduction quadrats in a study of competition and shade.

Data collected in the study of effects of fire in the Coastal Plain will give additional information of value in this project.

A comprehensive management research working plan for pine studies on the Mid-Atlantic Coastal Plain is being written.

FIRE DAMAGE STUDIES

Purpose

In the management of the mountain and Coastal Plain forests, fire is a destructive agency to be reckoned with at every step. The immediate visible tree destruction, the no less serious hidden decay which follows wounding, the possible changes in the composition of the forest and the soil, make fire an important subject for investigation. Fire damage studies are needed, therefore, not merely as a basis for appraising immediate and deferred financial loss, but also because fire usually has a vital relation to the kind of silviculture that should be practiced.

In the mountain region, the Station's fire studies have been directed towards determining the effect of fires upon standing timber, reproduction, other vegetative cover, and soil and litter characteristics, in order to find a true measure of damage, disclose any possible advantage of fire for silvicultural operations, and furnish information for sound protection plans and policies.

On the Coastal Plain, the studies have in view the determination of how much and what kinds of influence fires have upon the establishment and growth particularly of loblolly pine stands. Here the subject has two parts; first, the effects of accidental, uncontrolled fires, and second the effects of single or repeated controlled fires such as may be used with the idea of destroying accumulations of fuel and so preventing more destructive burns.

Fire Studies in the Mountain Region

Past Work

Since the inception of the project in 1922, emphasis on certain phases of the work has been changed several times principally because of changes in personnel. Beginning with extensive surveys of burned areas and the establishment of temporary plots for the determination of tree mortality after fires, the work progressed into a study of the influence of weather, fuel, and other factors on fire hazard. Later the effect of fire on forest soils was investigated. During the past several years, work on physical damage, particularly basal injury, to trees caused by fire, and the establishment of permanent experimentally burned plots has been stressed.

Current Progress

A major accomplishment was the establishment and experimental burning in December of a 15.7 acre plot on the Bent Creek Experimental Forest. Four other plots totaling 6.8 acres were established as controls. Measurements were taken on 6,300 trees; 390 quadrats were established for the study of effect of fire on tree reproduction; 30 minor quadrats for the study of Vaccinium and 4 tenth-acre plots for the study of laurel. Computations and summaries of data were made and establishment and fire reports prepared.

A promising method in sample plot procedure was used. Areas were checkerboarded into tenth-acre squares and field data recorded separately by these tenth-acre subplots. This method facilitates the computation and analysis of data and in addition provides a simple method for locating any unit or measured individual in the field.

A new and effective method was devised for determining approximate temperatures during experimental burning by means of Seger Cones and thin ribbons of fusible metal alloys. In the light to medium fall fire obtained on the plot mentioned above, the average temperature 6" above the ground, generated by burning leaf litter, was approximately 600° C. Slash piles produced temperatures as high as 1000° C. At 5 feet above ground temperatures generally reached 200° C; at 10 feet, generally 100° C; at 20 feet, 100° C. occasionally; and at 30 feet, 100° C. was not reached.

A total of 250 laboratory tests of the insulating value of the bark of four oaks and yellow poplar during the dormant season were completed. During the latter part of the work and at the time of analysis of data, the experimental technique appeared to be not entirely satisfactory. Some change in methods may be made before additional tests are run.

The accumulation of litter on Plot 34, Bent Creek, during the three years which have elapsed since the plot was burned, in April 1930, indicates that the litter had not reached the quantity present before the fire. Yearly deposition still exceeds yearly decomposition, which condition is likely to continue for another year or two.

The major working plan for the project was revised and several working plans for subprojects prepared.

1933 Plans

The plans made for this project prior to the curtailment of funds for travel included the establishment of additional burning plots on two other experimental forests, the reexamination of the Bent Creek plots, and a study of the efficacy of fire in eliminating or killing back laurel and rhododendron, preferably in cooperation with the management project. This program will probably have to be abridged by omitting the plots on other experimental forests than Bent Creek, and perhaps also the laurel and rhododendron studies. As an alternative to the proposed plots above mentioned, new plots will be established and burned at Bent Creek, on a site already selected. It is planned to use E. C. W. men for this work. Other work will consist of the computation of field data previously collected and additional investigations on bark insulation.

Fire Studies on the Coastal Plain

Past Work

Most of the work to date has been on the effects of burning under selected conditions. In 1929 an experimental area at Lanes, S. C., in longleaf and loblolly pine, was transferred from the Southern Station, 24 plots (5 1/2 acres) were established, and these have since been burned annually. Two longleaf pine plots (2/3 acre) at Summerville, S. C., which had been subjected to annual fires for a period of 13 years, have been utilized by the Station since 1930. In the Lanes group of plots an accidental fire in 1931 burned over one of the two check areas, killing many of the trees. The plots affected have since been rehabilitated and will be continued.

Current Progress

The accidental burning of one of the two check areas in the Lanes, S. C., group of plots necessitated a change in plans in this project. It was necessary to reexamine all trees over 2.5 inches d.b.h. as well as the reproduction quadrats. In addition a new check plot 1.75 acres in extent was established.

The reexamination showed that many trees on the burned plots had decreased in diameter during the past three years. Accordingly, bark thickness measurements were taken on all trees. The analysis of these data indicated that annual fires reduced double bark thickness approximately .1 inch, while the accidental fire reduced it about .2 inch. Further analysis of the data showed: (1) that height had little effect on bark thickness within a diameter class; (2) fifty nine percent of the variations in bark thickness were associated with variations in diameter; (3) variations due to error of measurements made with a Swedish bark measuring instrument were relatively small; (4) in this stand 11, 18, and 22 measurements per tree were necessary to give accuracy of .1 inch in double bark thickness 99 times out of 100 on 3, 6, and 9 inch trees respectively; (5) in future work in second growth longleaf pine stands such as the one studied a satisfactory expression of the relation between diameter and bark thickness can be obtained by drawing a line between points determined by taking single bark thickness measurements of 75 three inch trees and 150 nine inch trees.

The data taken at Lanes indicate that the mortality on the longleaf pine plots, which had remained unburned for 14 years and then were subjected to an accidental fire, was much heavier than on the plots which had been burned over annually for the past four years. However, since no data are available on effects of controlled burning on growth, site quality, and establishment of reproduction, this must not be taken as too strong an argument for the practice of controlled burning.

One of the controlled burning plots at Summerville, S. C., was subjected to its fifteenth annual fire.

1933 Plans

It is hoped that the lack of experimental forest areas on the Coastal Plain will be remedied in 1933, through the purchase of lands for national forests. Complete control of forest lands for experimental purposes is essential for any satisfactory study of the effects of fire and of the claimed advantages of controlled burning.

Plans which called for the establishment of permanent strip for the determination of amount and rate of mortality in loblolly stands following fire, quadrat studies on the effect of fire on the establishment of loblolly reproduction, and investigations on amounts of fuel in loblolly stands will probably be postponed. Curtailment of travel will permit only the regular examination and burning of the plots at Lanes and Summerville, S. C.

Growth - Mountain Hardwood Forests

Purpose

A knowledge of the growth-rate of forest trees is indispensable in forest management, since without it forecasts of future returns would be merely speculations. Without it, also, many silvicultural operations would be hazardous or impracticable. The subject deserves an allotment of funds comparable to those for the management or the protection project. No such funds have been available, and the work so far done has been financed from a small part of the allotment for the management project.

The purpose of this project is to determine (1) the growth-rate of the tree species in different forest types and condition classes, at different ages, and on different sites; (2) the best stocking of stands and the relation of present stocking to future growth-rate; (3) the rotation ages for different tree species and products; and (4) the best survey technique for making yield forecasts.

Past Work

Plots for periodic remeasurement of growth have been established at Berea, Ky., and in the Pisgah and Cherokee National Forests, and the Georgia Mountain Experiment Station.

Current Progress

The increasing amount of white pine reproduction, due possibly to an increased fire protection, indicates that white pine is likely to become a locally important component of future forest stands in the Southern Appalachians. This belief is strengthened by growth data obtained in Northern Georgia. White pine was found to grow faster than yellow poplar, its closest competitor, and the other associates, yellow pines and oaks.

1933 Plans

Work on growth as a separate project will be suspended during the fiscal Year 1934, but growth relations will be among the subjects studied in the proposed work under the management project for mountain forests.

PLANTING

Purpose

The scope of the planting project is limited to the testing of selected native native and exotic tree species for planting in the high spruce-fir country and the lower pine-hardwood forest.

Past Work

In the spruce-fir belt of the Black Mountains, near Asheville, N. C., at an elevation of about 5,500 feet, some 85 test plantings of 100 trees each have been made. Seventeen species, all conifers, have been set out. The testing of species at lower elevations has been done at Bent Creek, also near Asheville, at an altitudinal range of 2900 to 3000 feet. About 50 species, including both hardwoods and conifers have been planted in this locality.

Current Progress

In 1932 the major activity under this project was the examination of all trees in the Bent Creek plantations. In addition, two sample plots were established in plantations of Japanese red pine and Norway pine.

A summary of the data collected in the examination of the Bent Creek plantings discloses wide variations between the different species in survival, growth, and susceptibility to different forms of injury. The value of the data for generalization, however, is questionable. Most of the species are represented by only small plantations, and in the summary presented below the data from two or three local habitats have been grouped together. None of the plantings, moreover, are more than eight years old, and the juvenile development of stands is no sure index of future values.

From the tabulation given below it will be seen that survival has, in general, been rather high. The species showing unexpectedly good survival include Chamaecyparis thyoides, Pinus caribaea, Pinus taeda, and Pinus palustris. On the other hand Pinus resinosa proved rather less adaptable than was expected.

Survival in Plantings, Bent Creek Experimental Forest

(Elevation 2,000 to 3,000 feet)

Survival 70 to 100 percent					
Species	Age Years	No. of plantings	Species	Age Years	No. of plantings
<i>Albizia julibrissin</i>	4	2	<i>Pinus contorta</i>	6	1
<i>Castanea crenata</i>	4	1	" "	3	1
<i>Castanea mollissima</i>	6	1	<i>Pinus densiflora</i>	5	2
" "	4	1	" "	4	1
<i>Castanea sanguinii</i>	4	1	<i>Pinus palustris</i>	4	1
<i>Cercis canadensis</i>	4	1	<i>Pinus pungens</i>	3	1
<i>Cormus mas</i>	4	1	<i>Pinus rigida</i>	4	1
<i>Cormus sanguinea</i>	4	1	<i>Pinus rigida</i> <i>serotina</i>	3	1
<i>Chamaecyparis thyoides</i>	6	1	<i>Pinus sylvestris</i>	5	2
<i>Fraxinus oregonia</i>	3	1	" "	4	1
<i>Gleditsia triacanthos</i>	4	1	<i>Pinus taeda</i>	3	1
<i>Ilex opaca</i>	2	2	<i>Quercus alba</i>	5	1
<i>Juglans nigra</i>	5	1	<i>Quercus montana</i>	4	1
<i>Liriodendron tulipifera</i>	6	2	<i>Rhamnus purshiana</i>	7	1
" "	5	8	" "	6	1
" "	4	1	<i>Rhus coriacia</i>	4	1
<i>Picea glauca</i>	4	2	<i>Thuja occidentalis</i>	7	2
<i>Pinus caribaea</i>	6	1	" "	6	1
<i>Pinus contorta</i>	7	1			

Survival 40 to 69 percent					
Species	Age years	No. of plantings	Species	Age years	No. of plantings
<i>Abies concolor</i>	3	1	<i>Pinus densiflora</i>	2	1
<i>Acer saccharum</i>	7	1	<i>Pinus echinata</i>	6	1
" "	6	1	<i>Pinus monticola</i>	6	1
<i>Chamaecyparis lawsoniana</i>	3	1	<i>Pinus nigra poiretiana</i>	5	2
<i>Ginkgo biloba</i>	4	1	<i>Pinus resinosa</i>	6	2
<i>Libocedrus decurrens</i>	6	1	" "	2	1
" "	3	1	<i>Pinus sabiniana</i>	3	1
<i>Liriodendron tulipifera</i>	5	1	<i>Pinus sylvestris</i>	7	1
<i>Picea excelsa</i>	2	1	<i>Populus deltoides</i>	5	1
<i>Pinus contorta</i>	7	1	<i>Pseudotsuga taxifolia</i>	4	2
			<i>Quercus montana</i>	5	1

Survival less than 40 percent					
Species	Age years	No. of plantings	Species	Age years	No. of plantings
<i>Abies concolor</i>	7	1	<i>Picea sitchensis</i>	6	1
" "	6	1	<i>Pinus attenuata</i>	3	1
" "	3	1	<i>Pinus koraiensis</i>	4	1
<i>Castanea dentata</i>	5	1	<i>Pinus radiata</i>	4	1
<i>Cupressus macnabiana</i>	3	1	<i>Pinus resinosa</i>	7	4
<i>Larix leptolepis</i>	5	1	" "	6	1
<i>Larix occidentalis</i>	3	1	<i>Pistacia terebinthus</i>	4	1

In the matter of growth, loblolly pine (*Pinus taeda*) and southern white cedar (*Chamaecyparis thyoides*), neither of which is native to the mountains, excelled all other species. It is also worth noting that the western species are almost all to be found in the group having the slowest growth. Yellow poplar (*Liriodendron tulipifera*) and white oak (*Quercus alba*) are also to be found in the slowest growing group but in these cases the reason is probably not so much the inherent ability of the species as the fact that deer seem to prefer them for food.

In the tabulation below, a height growth of less than 0.5 feet per year can be considered unsatisfactory, 0.5 to 0.9 feet per year as fair, 1.0 to 1.4 satisfactory, and greater than 1.4 excellent

Mean Annual Height Growth of Species Planted at Bent Creek

Pisgah National Forest

Less than 0.5 feet	0.5 to 0.9 feet	1.0 to 1.4 feet	Greater than 1.4 feet.
<i>Abies concolor</i>	<i>Castanea crenata</i>	<i>Albizzia julibrissin</i>	<i>Pinus taeda</i>
<i>Chamaecyparis lawsoniana</i>	<i>Castanea dentata</i>	<i>Pinus caribaea</i>	<i>Chamaecyparis thyoides</i>
<i>Fraxinus oregonia</i>	<i>Castanea mollissima</i>	<i>Pinus densiflora</i>	<i>Pinus echinata</i>
<i>Juglans nigra</i>	<i>Castanea sanguinii</i>	<i>Pinus resinosa (Vt.)</i>	
<i>Liriodendron tulipifera</i>	<i>Cercis canadensis</i>	<i>Pinus rigida</i> <i>serotina</i>	
<i>Picea excelsa</i>	<i>Cornus sanguinea</i>	<i>Pinus sabiniana</i>	
<i>Picea glauca</i>	<i>Cupressus macnabiana</i>	<i>Pinus sylvestris</i> (Belgium)	
<i>Picea sitchensis</i>	<i>Gleditsia triacanthos</i>		
<i>Pinus contorta</i>	<i>Larix occidentalis</i>		
<i>Pinus koraiensis</i>	<i>Larix leptolepis</i>		
<i>Pinus monticola</i>	<i>Liriodendron tulipifera</i>		
<i>Pinus palustris</i>	<i>Pinus attenuata</i>		
<i>Pinus resinosa (Minn.)</i>	<i>Pinus nigra</i> <i>Poiretiana</i>		
<i>Pinus sylvestris</i>	<i>Pinus densiflora</i>		
<i>Pseudotsuga taxifolia</i>	<i>Pinus resinosa</i>		
<i>Quercus alba</i>	<i>Populus deltoides</i>		
<i>Quercus montana</i>			
<i>Rhamnus purshiana</i>			

All the plantations under observation are located in the Pisgah Game Refuge which is heavily stocked with deer. It is rather surprising, therefore, that only seven species showed more than 10 per cent of the trees injured by browsing. In addition to those listed below, sugar maple was rather heavily injured by rabbits but the effects were obscured by frost damage.

Per Cent of Trees Killed and Injured by Deer (Browsing and rubbing)

<u>Species</u>	<u>Per Cent</u>
Yellow poplar	47
Scotch pine	44
White oak	35
Pond pine	29
Cascara	20
Chestnut oak	13
Douglas fir	13

Frost injury is difficult to recognize with certainty, since it may be confused with the effects of disease, drought, and possibly insect injury. At the time of the examination, however, frost was credited with damaging five species more than 10 per cent. These were honey locust (Gleditsia triacanthos) 44 per cent, sugar maple (Acer saccharum) 37 per cent, Mimosa (Albizia julibrissin) 31 per cent, yellow poplar (Liriodendron tulipifera) 28 per cent, and black walnut (Juglans nigra) 21 per cent.

Other forms of injury noted in the examination were trampling, insect damage, and disease. Two pines, lodgepole (Pinus contorta) and loblolly (Pinus taeda) are rather heavily infected with leaf rust and the species of Castanea are suffering from chestnut blight and a twig blight, but otherwise very little disease is apparent in the plantings. Insect damage is scattered and no particular species seems to be affected. Trampling and other mechanical injury is, of course, accidental.

Future Work

Future work on this project is to be held in abeyance pending the allocation of sufficient funds. Without expanding the project beyond its present scope it would be desirable to provide for the remeasurement of all plantings in the spruce-fir belt within the next year or so and at five-year periods after that.

BOTANICAL STUDIES -- PHENOLOGY

Purpose

Successful silviculture calls for a reasonably complete knowledge of the characteristics and behavior of the different species of trees when growing under different conditions. One subject of considerable importance in the chronological progress and sequence of the life activities, such as the seasonal duration of the growth period, the dates when leafing, flowering, seed ripening, etc., begin and end, and similar periodic phenomena.

The time periods of these activities differ within a given locality as affected by site and local climatic conditions, and they vary from locality to locality under the influence of geographic climatic variations. They also vary from year to year. The assemblage of such information is therefore a long-time matter, to be worked out according to carefully prepared plans with the cooperation of especially qualified observers. The selection of interested and capable cooperators so situated as to be able to make regular periodic records from season to season and year to year in an exceedingly difficult matter. The progress of such a project is therefore likely to be slow.

Past Work

This project was begun in 1929 with the preparation of plans calling for observation of life activities of a small number of species. Up to the present very few cooperators have been discovered who can furnish the type of information desired.

Current Progress

In 1932 phenological data were received from six sources; not all the observers have yet been heard from. A series of three weather stations were established on the Bent Creek experimental forest with the cooperation of Mr. L. T. Pierce, local representative of the Weather Bureau engaged in fire weather research. These stations are at altitudes of 2100 feet (near Bent Creek), 2300 feet, and 2500 feet (near the boundary of the Forest on Glenn Bald). The chief purpose of this installation is to study the effects upon vegetation of the frost pocket in the Bent Creek Valley.

1933 Plans

New observers are being started on the work for 1933. Aside from this the project is being held in abeyance because of the demands of other work upon the small funds available this year.

FOREST INFLUENCES

STREAMFLOW AND EROSION

Purpose

The major purpose of the streamflow and erosion project is to determine the comparative efficiency of different types of vegetative cover for watershed protection in the Southern Appalachian Region. This purpose is being carried out through two closely related lines of investigation. The first involves plot studies of the comparative efficiency of certain types of vegetative cover (or its absence as in the case of eroding fields) in influencing absorption and percolation and in protecting the soil from erosion. A second line of investigation is an extensive study of the organic layers of the soil profile (humus type) as influenced by the vegetation type, coupled with an examination of the effectiveness of different humus types in governing absorption and percolation of precipitation and in protecting the soil from erosion.

Current Progress

Beginning with July 1, 1932, continuous records have been made of the amount of stormflow following each storm from 10 permanent plots on the Bent Creek Forest. From these plots, representing five common cover types, stormflow was measured as surface runoff and also as subsurface flow at 12 inches. These continuous records are the first of their kind ever obtained in the Southern Appalachian Mountains. These records and others will serve as a basis for interpreting the movement of stormflow from representative cover types within the region.

The usefulness of the records will increase with the continuation of observation. Sixty-six rain storms and two snow storms occurred during the 12 months period ending June 30, 1933. A summary of the nature of these storms, together with a record of stormflow, is shown in accompanying tables. (Tables 1 and 2.)

Table 1. Surface runoff of different types of forest cover from 30 storms classified as to total precipitation and maximum intensity. Period July 1, 1932 to January 1, 1933.

		Storm class precipitation in hundredths of inches.					
25 - less		Storm class Maximum intensity range 20 minute period					
25 - less		Number of storms					
26 - 50		Average total precipitation per storm, inches					
26 - 50		Average maximum intensity per storm, 20 min. period					
51 - 100		Total duration					
51 - 100		Average per cent surface runoff. Plots 1 E & 2W (White oak, black oak, scarlet oak)					
51 - 100		Average per cent surface runoff. Plots 3N & 4S Old-field pine 25 yrs.old					
101-over		Average per cent surface runoff. Plots 5E & 6W Raked yellow pine-hdwds.					
101-over		Average per cent surface runoff. Plots 7E & 8W (Control 5E & 6W) Yellow pine-hardwoods.					
101-over		Average per cent surface runoff. Plot 9 N. Old-field restocking pine					
101-over		Average surface runoff Plot 10S. Old-field grass covered.					

Table 2.

Surface run-off different types of forest cover from thirty-six storms. Classified as to total precipitation and maximum intensity. Period - January 1, 1933 to June 30, 1933. Bent Creek Experimental Forest.

		Storm class precipitation in hundredths of inches					
		Storm class Maximum intensity range 20 minute period					
		Number of storms					
		Average total precipitation per storm In inches					
25 - less	.01 - .10	13	.11	.047	1	35	.558
26 - 50	.01 - .10	3	.34	.06	5	40	3.18
26 - 50	.11 - .20	3	.41	.14	3	33	2.81
26 - 50	.21 - .50	1	.26	0	10	2.06	.16
50 - 100	.01 - .10	4	.76	.07	14	37	4.62
50 - 100	.11 - .20	6	.69	.16	3	19	3.26
50 - 100	.21 - .50	2	.59	.36	0	50	3.46
101-over	.11 - 20	1	1.09	.19	7	0	4.38
101-over	.21 - over	3	1.71	.68	11	20	3.78
		Average maximum intensity per storm 20 minute period					
		Total duration					
		Average per cent surface runoff. Plots 1E and 2W (White oak, black oak, scarlet oak.)					
		1.042	1.119	.813	.099	.13	.13
		Average per cent surface runoff. Plots 3N - 4S Old-field pine 25 yrs. old.					
		45.22	2.30	.59	1.08		
		Average per cent surface runoff. Plots 5 E and 6W Raked yellow pine-hardwood					
		.13	2.52	2.46	.84	3.23	
		Average per cent surface runoff. Plots 7E and 8W. (Control 5E and 6W) Yellow pine-hardwood					
		2.73	16.66	1.09	0.75		
		Average per cent surface runoff. Plot 9 N. Old-field restocking pine					
		0	0	0.50	5.01		
		Average per cent surface runoff. Plot 10 S Old-field grass covered.					
		22.39	3.74	1.13	0.72		
		23.94	3.21	5.49	7.22		

It is apparent from those data that old-field pine stands (Plots 3, 4, and 9) effectively control excessive surface runoff of precipitation and that whenever fields abandoned for agriculture present a serious erosion and flood menace the establishment of pine on such land offers a practicable control of these evils. Also it is demonstrated that natural grass cover, such as broomsedge (Plot 10) is effective in controlling both erosion and excessive surface stormflow on the areas under observation.

By far the greatest amount of surface runoff comes from the oak-pine area (Plots 5 and 6) from which the litter has been removed for the past three seasons. Here the surface runoff amounted to from 10 to 20 times that of adjacent undisturbed areas used as controls (Plots 7 and 8). These results afford ample evidence that wherever the litter of the forest floor has been removed either by fire or for use as bedding or other purposes, the amount of surface runoff will be greatly increased and may lead to a serious erosion and flood menace.

Observations of surface runoff from an experimentally burned oak-chestnut area as compared with an adjacent unburned control area showed a considerable increase in runoff, brought about by the burning. Particularly was this evident on areas of 40 per cent or more slope.

The observations to date on the runoff from the 10 original plots under investigation are valuable not alone for the comparative data for different vegetative cover types which have been obtained, but the study has also served to orient the problem and to develop desirable field methods and plot procedure. Experimental technique has been developed permitting the study of water absorption and stormflow induced by artificially supplied precipitation to small areas in site under natural vegetative cover types. This procedure has proved to be satisfactory and furnishes a promising method for obtaining further data pertinent to forest and water relations.

In all 26 plots have been established on the Bent Creek experimental forest for continuous observation of stormflow following each storm. These plots are grouped as follows:

Burned areas as compared with unburned areas in oak-chestnut type..... 8 plots

Baked areas from which litter has been removed annually as compared with undisturbed areas in yellow pine-hardwood type..... 6 plots

Old-field stands as compared with pasture without tree cover 4 plots

Uniformity tests of equal areas, yellow pine-hardwood type.. 8 plots

Progress has been made in expanding knowledge of the humus types within the Southern Appalachian Region, through a study of organic layers of the soil profile of the runoff plots at the time of installation. The final objective of this study is a field classification of humus types, based primarily on observation of the soil profile together with a knowledge of the characteristics of the soil horizons. To obtain this information

characteristic humus types are to be compared on the basis of significant laboratory analysis with particular reference to physical structure as related to absorption and percolation of water to organic content, and to microbiological activities.

A project progress report giving complete tables of records, graphs, charts is in preparation.

1933 Plans

Plans for the coming year include continued observation of runoff from all the permanently installed erosion and runoff plots. They also include observations from larger areas than are possible under plot methods. Use will be made of dams with V-notched wiers and water level recorders so installed as to measure the stormflow from small areas constituting miniature watersheds. Continuous precipitation intensity records will be kept. In addition it is planned to follow out a field study of absorption and porosity of different humus types, using a special apparatus designed to furnish actual time in seconds required for a given humus type to absorb a given number of inches of water under controlled conditions.

It is also planned to extend the study of humus types to include observations on vegetation problems, associated with the rehabilitation of denuded and eroded lands. The object in view in this latter study is to increase information as to intermediate and minor vegetative cover types in the reestablishment of forest cover on bare and denuded lands.

BIOLOGICAL INVESTIGATIONS

Thomas D. Burleigh, Associate Biologist

U. S. Biological Survey

Activities during the past year have, as heretofore, been rather varied, and have been concerned with definite projects as well as with the continuation of studies dealing with distribution and life histories.

Rodents and Silvicultural Practice

Data secured over a period of several years had indicated a relative scarcity of rodents on areas where their presence in any numbers might possibly have influenced to some extent natural reproduction. It was felt advisable, however, to carry on more detailed studies to determine beyond any question the actual effect of these small mammals under changed conditions resulting from fires and logging. Experience in the past has shown that a changed environment has often created problems in wild life distribution that originally did not exist, and it was with this thought in mind that these projects were undertaken. Summarizing briefly the results obtained to date, it was found that fires had surprisingly little effect on the rodent population of any given area. Sample plots established on rather severe burns yielded practically the same number of mice as check plots on unburned forest land, and indicated an almost complete survival under decidedly adverse conditions. Considering the necessity for as rapid natural forest replacement as possible on such burnedover land the effect of these rodents in destroying future seed crops because of the scarcity of other natural food supplies may ultimately prove of serious consequence and suggest radical control measures.

In the case of logging operations a situation was found to exist that may prove to have an adverse bearing on securing a future timber crop, but fortunately this can be easily remedied. As is invariably the custom where logging is carried on, slash was left scattered over the ground and here rodents were apparently attracted by the exceptional protection afforded them from their natural enemies. Sample plots established on such areas indicated a rodent population far in excess of that found on uncut forest land, and suggested a severe check to future reproduction. Should future studies show this to be so it may possibly prove necessary to pile and burn all slash.

In connection with these rodent studies, experiments have been carried on to determine as closely as possible the normal nightly activities of mice, especially as regards the actual distance they cover in their forays for food. Live traps were used, and the mice caught so marked on the ears as to be readily identified when retaken at other spots. One

male white-footed mouse, Peromyscus leucopus, caught in August and taken again the following February fully a mile from where it was originally trapped, gives some indication of the distance these mammals travel under normal conditions.

Game Management

Game management involved several distinct fields of study. One was the relationship of predators to the game bird population, emphasis being placed on actual status of the gray fox because of local sentiment prevalent in the Southern Appalachians protecting this animal from molestation. While too definite statements are not as yet justified, it appears now that the gray fox does not deserve its reputation for destructiveness, and that its value in holding rodents in check more than offsets the little harm it does to game birds.

The rapid increase of deer on the Pisgah National Forest during years of rigid protection developed a situation demanding intensive research as to the possible effect of overcrowding and means of remedying this situation. An examination of specimens taken during the regulated hunt on the Refuge this past fall revealed an unusually heavy infestation by a worm, Gongylonema sp., a well-known parasite affecting ruminants. These long, thin, hair-like worms were found in fully ninety per cent of the animals examined, the tongue and throat in some cases being so badly infected as unquestionably to influence more or less the health of the individual animal concerned. The various species of Gongylonema attacking the ruminants in this manner have rarely developed sufficiently heavy infestations to cause serious damage, and as yet have not constituted a very serious menace to wild game. It is entirely possible, however, that where too many deer occur on a given area such a parasite might materially affect these animals. It is known that an intermediate host is required, and while certain beetles have been found to be responsible for the spread of this parasitic worm, further studies will be necessary before any definite conclusions can be reached. Roundworms affecting the mouth and teeth were noted in only a few animals. Apparently they are a factor of relatively little importance.

The introduction of beaver into Western North Carolina by the Biological Survey has met with marked success, and if local sentiment continued to protect these animals they should in time attain their former numbers here. This will not only result in regulating streamflow, and so preventing losses from erosion, but will add a valuable source of revenue to the State from the sale of furs taken under regulated trapping. Although it has proven impossible to accurately estimate their numbers, concensus of opinion has placed the present population of beavers on the Biltmore Estate at approximately twelve. As five were originally liberated in November, 1931, this increase has been very gratifying.

Studies of Life Histories

Studies of life histories, and of distribution and abundance, of both birds and mammals primarily important in any biological investigation have been continued as in past years. Except for a month's intensive field work in Georgia this phase of the work has, to a large extent, been carried on in the mountain counties of North Carolina. Brief field trips have been made into the Great Smoky Mountains, and to the Piedmont section

(over)

of South Carolina and Georgia. Specimens of taxonomic interest have been collected to be used in determining life zones and in limiting the boundaries of the various geographical races.

Public Relations

Public interest in wild life has been very marked during the past year, and has necessitated an increasing amount of time away from actual field work in satisfying the continual requests for more or less formal talks before the various civic organizations and schools. These talks have dealt either in a general way with the bird and mammal life of the Southern Appalachians, or with the economic value of this wild life, and because of the interest manifested the time so spent has been considered well justified. One tangible result to date has been the introduction of courses in bird study and of wild life conservation into the High Schools of Buncombe County, of which Asheville is the County seat. Such a step promises much for the future of wild life in Western North Carolina.

FOREST INSECT INVESTIGATIONS

R. A. ST. George, Associate Entomologist

Bureau of Entomology

I. Beetle Abundance and Climate

During the calendar year 1932 the most notable outbreaks of forest insects in the southeastern section of the country were those caused by the southern pine beetle, Dendroctonus frontalis Zimm.

Several other insects also were active but none of primary importance. Thus, Ips barkbeetles were associated with longleaf and slash pine trees that were dying in a considerable area extending over southern Georgia and northern Florida, which region had been effected by drought for some time previous to attack.

Further, Agrilus and other secondary borers were found infesting large numbers of overmature oaks which were dying in the forest area in Campbell and Bedford Counties, Virginia, where the trees were believed to have been weakened by conditions of drought.

Other minor infestations were caused by the tip moth, Rhyacionia frustrana Comst. This injury was found in slash pine sample plots located at Franklin, Va., where about 10 per cent of the tips were estimated as being affected.

The yellow striped oak worm, Anisota senatoria, was quite abundant throughout western North Carolina and eastern Tennessee during August and September. It was quite common to find the smaller oaks completely defoliated.

In forest nurseries, white grubs (Phyllophaga species) caused considerable damage to pine seedlings. Such injury was reported from state-controlled as well as from private-owned nurseries. Those affected were located in the states of West Virginia, Kentucky, Tennessee, North Carolina, South Carolina and Alabama.

The Southern Pine Beetle

The history of outbreaks of the southern pine beetle in 1932 is, in the main, a repetition of conditions found prevalent during previous years. That is, where a marked deficiency in rainfall occurred for a pronounced period, the beetle became active. This condition of drought, occurring for the previous two consecutive years, combined with a mild winter, made conditions especially favorable for increase in beetle population during the spring of 1932. As the result of such conditions an entire generation of beetles developed between October 1931 and March 1932, during which period they are usually in a dormant condition. Severe outbreaks undoubtedly would have occurred during the following spring and summer months had not unfavorable weather conditions held them in check. The factors mainly responsible for this were believed to be the freeze which occurred between March 7 and 14, when near zero temperatures were experienced, and the resumption of rainfall between January and May 1932. As a result of this, beetles were scarce during the early spring months and did not occur in numbers again until midsummer when another deficit of several inches of rainfall occurred.

Quite in contrast to former years the most pronounced injury caused by this beetle occurred in the Coastal Plain region, rather than in the Piedmont and mountainous areas as was the case heretofore.

A survey of the Smoky Mountain National Park, made during August, indicated that the severe infestation of 1931 had been checked, since no further injury could be detected at that time. Only a few minor outbreaks were found in the mountainous areas in general and these were located within the Asheville Basin.

In the Piedmont area a few infestations occurred around July 1, and as a result considerable timber of merchantable size was killed. Thus at Farmington, N. C., shortleaf pine trees that would cut from 500 to 2,000 board feet of lumber per tree, and that were located on a 50 acre tract, were found being rapidly destroyed when this area was visited on September 2. A portable sawmill had already cut out about 40,000 board feet on 1 1/2 acres of land up to that time. Another outbreak of similar character occurred at Wilmington, N. C.

In the Coastal Plain region severe infestations of the southern pine beetle were reported from the following localities: Franklin, Va., Charleston, S. C., and Evangeline County, La. At Wilmington, N. C., several hundred mature slash pine trees were affected. These were located on a 2,500 acre tract of land. At Charleston, S. C., about 30 acres of merchantable pine was attacked which would cut up to 25,000 board feet per acre. In Evangeline County, La., over 1,000,000 board feet of pine timber was reported to have been affected and salvaged.

II. Tree Injection Studies

During 1931 poisonous solutions were injected into the sapstream of both healthy and of beetle-attacked trees for two purposes: (1) brood control and (2) to preserve the wood against attack by insects and decay. During 1932 observations were continued on these treatments and certain additional tests were made.

1. For brood control purposes experiments were conducted with several poisons that previously had been proven to be effective against the southern pine beetle, in order to determine the minimum lethal dosages which could be applied. The results obtained from these experiments indicated that for trees up to 6 inches d.b.h. and 35 feet high (the average size attacked) both the egg and the parent adult stages of this beetle could be killed with as little as 3 grams of sodium arsenite, 10 grams of sodium fluorido, 10 grams of mercuric chloride and a 12 per cent solution of pyridine. In a few instances kills were obtained with lower dosages, such as with 1/2 gram of sodium arsenite.

2. For wood preservation and rustic purposes. Pine, oak, and hickory trees, injected during 1931 by introducing an ounce of certain poisons in the sapstream of these trees, were found to be well preserved after one year's time.

Similar results were obtained by injections made during 1930, when from one to two ounces of the poisons were used. The chemical which stood out above all the rest in this respect was mercuric chloride. Logs containing this poison were found to be in a perfectly sound condition. Such had tight bark, bright sapwood and were unattacked by insects or fungi. This condition prevailed regardless of whether the trees were left standing or whether they were felled and buried half their length in the ground.

Those sections treated with zinc meta arsenite and sodium arsenite were also quite promising but slightly less so than those treated with the chemical mentioned above. Logs treated in a similar manner two years ago were in as good a condition as were those treated in 1931.

III. Physiological Studies

Fundamental research work was continued during the year and much additional information was obtained relating to the interrelation of blue stain fungi and insects in causing the sudden death of attacked

trees. Further data were obtained on the water relations in healthy and attacked trees. Such information is especially valuable in connection with the injection of poison into the sapstream of trees. Results of further studies conducted during 1932 with regard to determining the accuracy of the increment core method as a means of obtaining an index to changes occurring in the seasonal variation of the moisture content of trees, revealed that this method was a fairly reliable one, especially for general trends. It appeared to be a little low when used in comparison with the values obtained by means of cross sections.

IV. Forest Nursery Studies - The White Grub Problem

Because of continued requests from State, as well as from private owned nurseries for the control of white grubs injurious to forest tree seedlings, cooperative experiments were begun during the early spring months on this problem.

Experiments were devised for both preventive and remedial purposes. For the former lead arsenate was applied to the soil when the seed beds were prepared. For the latter carbon bisulphide was used.

Sample plots were laid out at Clayton, N. C., in cooperation with the Department of Conservation and Development, Raleigh, N. C., and at Camden, S. C., in cooperation with the State Forestry Commission, Columbia, S. C.

Lead arsenate was applied to the soil in different dosages and also mixed in it in different ways and at various depths so as to note the effect of the poison on the plants as well as on the insects.

Preliminary results obtained from these experiments indicate the following relations:

1. That there is possibly a correlation between the extent of injury caused by the beetles and climatic conditions. During conditions of drought the beetles appear to go deeper in the soil where more moisture is present. Also, if a particular area is watered sufficiently to keep the top soil quite moist during such a period, the injury there is apt to be quite severe.
2. That the application of 1,500 pounds of lead arsenate per acre, as is recommended for the control of the Japanese beetle, when applied to the light sandy soils in the Coastal Plain region in the Carolinas, appears to be too heavy a dosage for pine seedlings. Although it is effective in preventing attack by Phyllophaga species it has an injurious effect on the plants in that it causes a stunting of their growth which may reach as high as 40-50 per cent, depending upon how the seed beds are prepared.

Lower dosages appeared to be effective and not injurious to the plants. Sufficient work has not been done on the latter up to the present time to warrant including the results in this report.

Applications of carbon bisulphide emulsion at the rate of three pints per square foot, when the stock emulsion was diluted by adding 50 gallons of water to three quarts of it, proved to cause a stunting of the growth also. Such an application was effective against *Phyllophaga* species. Other tests using weaker dosages are planned for the coming year.

FOREST FIRE WEATHER RESEARCH

L. T. Pierce, Assistant Meteorologist

U. S. Weather Bureau

The fire weather service in the Southern Appalachian region, officially designated by the Weather Bureau as District No. 8, was placed in operation on March 1, 1932. Preparations for rendering this service have been under way for nearly a year. District No. 8 is intended eventually to extend over the states south of Pennsylvania, and include the entire mountain region. At first, however, the service is being operated only in the mountainous sections of North Carolina, eastern Tennessee, northern Georgia and southwestern Virginia.

The network of reporting stations was completed early in February 1933, and has been functioning during the spring fire season. The following is a list of station locations from which daily reports were received: Bent Creek experimental forest, Pisgah Forest, N. C., Franklin, N. C., Long Creek, S. C., Damascus, Va., Hot Springs, N. C., Pineola, N. C., Point Lookout, near Old Fort, N. C., and Waynesville, N. C. In addition to these a record station is maintained at Smokemont, N. C., where continuous records of temperature and humidity are kept by means of a hygrothermograph. Observers are for the most part closely associated with National and State forest services.

The operation of this service is as follows: The observers record three observations each day throughout the year at 8 a.m., 1 p.m., and 6 p.m., E. T. During the fire seasons only, they telephone or telegraph these observations at 8 a.m., to the headquarters office in Asheville. Here the data are charted on specially prepared maps, and used as a basis for the preparation of forecasts or warnings of weather conditions favorable to the starting and spread of forest fires. These are specialized forecasts, and include such data as cloudiness and precipitation, wind direction and velocity, and humidity changes. These forecasts are distributed to Forest Supervisors and District Foresters at the expense of the Weather Bureau, and reach the general public through newspapers and radio broadcasts.

In addition to the research in forest fire weather forecasting, cooperative work with the Appalachian Station is being done in the collection and analysis of weather records. This cooperation included aid in establishment of meteorological stations on the Bent Creek experimental forest.

APPALACHIAN FOREST RESEARCH COUNCIL

The eighth meeting of the Council, held at Asheville June 17-18, 1932, was devoted largely to a review of the past work and project plans of the Appalachian Station, presented by members of the Station staff. Eleven Council members and twenty-six guests were present. A field trip was made to inspect the experiments under way on the Bent Creek experimental forest. Forest investigations by the North and South Carolina State forest services and by Duke University were discussed by State Foresters J. S. Holmes and H. A. Smith, and by Dr. C. F. Korstian.

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January 1, 1932 -- June 30, 1933

(Not including prepared addresses)

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No. 0.73

APPALACHIAN FOREST RESEARCH COUNCILProceedings of the Eighth Meeting
Asheville, N. C., June 17-18, 1932

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APPALACHIAN FOREST RESEARCH COUNCIL

Minutes of Meeting Held June 17-18, 1932, Battery Park Hotel

Asheville, N. C.

The eighth meeting of the Appalachian Forest Research Council was called to order by the President, W. D. Tyler, at 10:30 a. m., June 17. Eleven members and twenty-six guests were present:

Members

J. A. Burruss, Blacksburg, Va.	J. H. Pratt, Chapel Hill, N. C.
P. R. Camp, Franklin, Va.	B. L. Roberts, Richwood, W. Va.
Thos. H. Clagett, Bluefield, W. Va.	H. A. Smith, Columbia, S. C.
E. H. Frothingham, Asheville, N. C.	H. L. Tilghman, Marion, S. C.
J. S. Holmes, Raleigh, N. C.	W. D. Tyler, Dante, Va.
Wm. J. Hutchins, Berea, Ky.	

Guests

C. A. Abell, Asheville, N. C.	C. F. Korstian, Durham, N. C.
Mrs. C. A. Abell, " " "	Wm. P. Kramer, Asheville, N. C.
L. I. Barrett, A " " "	Josephine Laxton, " " "
H. L. Blomquist, Durham, N. C.	H. J. Loughead, " " "
D. E. Bradshaw, Asheville, N.C.	A. L. MacKinney, " " "
J. H. Buell, " " "	E. M. Manchester, " " "
E. D. Burchard, " " "	M. A. Mattoon, " " "
Mrs. T. H. Clagett, Bluefield,W.Va.	Martha Norburn, " " "
W. G. Damtoft, Canton, N. C.	R. M. Nelson, " " "
C. F. Evans, Asheville, N. C.	Elisa M. Pearson, " " "
V. E. Hicks, " " "	L. T. Pierce, " " "
C. R. Hursh, " " "	I. H. Sims, " " "
B. J. Huckenpahler, " " "	Mrs. H. A. Smith, Columbia, S. C.

The reading of the minutes of the Seventh Meeting of the Appalachian Forest Research Council was dispensed with, inasmuch as each member had received mimeographed copies of the minutes.

The following committees were appointed by the chair:

RESOLUTIONS COMMITTEE

F. H. Clagett, Chairman
J. S. Holmes
J. H. Pratt

NOMINATING COMMITTEE

J. A. Burruss, Chairman
P. R. Camp
H. L. Tilghman

AUDITING COMMITTEE

H. A. Smith
B. L. Roberts

COORDINATION COMMITTEE

J. H. Pratt, Chairman
T. P. Cooper
Chapin Jones

FIRE STUDIES COMMITTEE

H. L. Tilghman, Chairman
G. A. Cardwell
J. O. Hazard
B. L. Roberts

Mr. Tyler: I was recently asked in a communication from one of my friends in Virginia - a man who is very much interested in the general forestry work going on in the country - what was the particular duty of the Appalachian Forest Research Council. In answering his letter I used these paragraphs, which I would like to read to you:

"This Council, as you understand, is a Council advising and endeavoring to hold up the hands of the Appalachian Forest Experiment Station which, as you know, is located at Asheville, N.C.

"The Appalachian Forest Experiment Station is, of course, one of the several stations scattered over the country, all of which exist for the purpose of doing such experimental work as may result in the establishment of well-determined conclusions upon which may be based practical plans for reforestation of lands not suited to agriculture. The Stations further investigate and endeavor to arrive at proper methods of treatment of all insects and other pests whose activities tend to destroy and lessen the value of the forest."

I believe that our deliberations in this meeting should be generally guided by that line of thought.

The program that has been arranged for today's meeting calls first for an address on the Aims of Forest Research by Mr. E. H. Clapp of the National Forest Service. Unfortunately Mr. Clapp is unable to be here today and I have asked Colonel Pratt to speak in his place.

Colonel Pratt: I think Mr. Tyler has given a pretty good summary of the aims of forest research in the paragraph he has just read. We are particularly interested in these aims as applied to the Appalachian Forest Experiment Station. In all the research work we advocate, desire, and wish the Station to take up, we should be able, in some way, to show the members of Congress that each particular phase will contribute something of value to the commercial side of forestry. I have been before numerous committees in Congress, and I find that the first question raised is, what is the value of the proposed research to the people of the country, to the industries, and to the owners of forest land? These investigations, therefore, must not be purely scientific, and we must be able to show that most, if not all, of our forest research does have a direct value to industry.

I believe all the appropriations we have asked for, for all lines of forest research in this section, have been shown to have a direct bearing and value to the commercial forests and to the conservation of our forest lands, increasing the productivity of the forest. If we review the general lines of investigation presented in the eleventh annual report of this Station, we can trace all the projects back and find them to have a direct industrial applicability.

All this means, of course, that forest research that cannot be so classified will have to be pursued by other institutions especially endowed for such work. Later I will introduce a resolution with regard to the need, in this general Southern Appalachian region, of an endowed institute of forest biology, which should be able to take up all phases of research in the study of forest life and the factors affecting it.

Just at this time, as you all know, our own particular Station will be handicapped by the lack of appropriations that we had hoped we were going to have for the next two years. This we regret most sincerely, since this work should go on along lines already planned. The total appropriation of the Appalachian Station, when first established, was about \$17,300 a year. The results of that first work brought about an increased appropriation and correspondingly larger results. I believe our Station is going to be able to carry on, in spite of the cuts in appropriations, as effectively and as efficiently as in the past. We have a group of men who are intensely interested and devoted to the work of the Station. We have the cooperation of the various state foresters and educational institutions, and I believe that in coordinating that cooperative work we will be able to carry on in our forest research work and make it even more effective and of even more value than in the past.

Mr. Tyler: The next thing in order is a resume of the Station's activities during the past year. First on the list we will hear from Mr. Frothingham.

Mr. Frothingham: The general purpose and character of the Station's work need not be discussed here, as they are presented in the Station's annual report and more briefly in the summary of activities dated April 30, which has been distributed to you. I want only enough time for some general remarks preliminary to the reports on individual activities.

During the past year the Station suffered some reductions in its appropriations for investigative projects, but these have not yet been so drastic as to cause really serious loss of efficiency. They have served to impress us with the present imperative need for economy, but fortunately we have only had to shorten sail a little and not to give up any large part of the load.

We hope that the Station may weather what may be left of the depression without any damaging loss. Those who appreciate the importance of continuity in research will realize that research depends not only upon a trained personnel, but also upon a personnel which is acquiring, by a process of self education, a proficiency in the specific problems upon which it is working. Research is therefore peculiarly dependent upon the maintenance of personnel. The loss of one individual who has developed an acquaintance with problems and a proficiency in technique of solution is likely to set back the work incalculably. If the convictions are true that have justified your past support of forest research, they will be increasingly true as population increases and as new uses appear for forest lands and forest products. Since continuity is the essence of research, we believe that in times of depression as well as in prosperity every reasonable effort should be made to safe-guard the research organization.

While the funds for purely research activities have this year suffered some reduction, this Station received \$30,250 for special construction under the emergency employment act of last winter. With part of this (\$19,250) six small buildings were constructed at Bent Creek as follows: 3 laboratories, a greenhouse, a bunk and moss house, and a cottage for a resident ranger. This improvement included the construction of short roads to the buildings, a sewage line, and connections with the county water supply, with an electric power line, and with the Asheville telephone system. The remaining \$11,000 was administered by the Pisgah National Forest in building four miles of new road through the experimental forest.

Three additions to our personnel and one transfer were made during the year. You will recall that several times in the past the Council has recommended to the Secretary of Agriculture that investigations be undertaken by the Weather Bureau leading to a fire weather forecast service for the Southern Appalachians. These studies were started in March upon the arrival of Mr. L. T. Pierce of the Weather Bureau, from whom you will hear later. Another new member of the staff is Mr. E. M. Manchester, resident ranger at Bent Creek, formerly with the Pisgah National Forest organization. The third is Mrs. Mary P. Gudger, stenographer.

Dr. R. M. Nelson, formerly our representative from the Office of Forest Pathology, Bureau of Plant Industry, was transferred to the Forest Service with the title of Silviculturist. This transfer is decidedly gratifying to us because it greatly strengthens our fire damage investigations; but it leaves the field of forest pathologist without any cooperating representative at the Station.

Direction of the Bent Creek construction work diverted a good deal of time from research activities, and there were other diversions, notably our participation in the nation-wide collection and compilation of statistics on forest land, stand, growth, and drain, along the lines of the so-called Capper Report, published in 1920. The Station's share in this "extensive revision" covered the States of West Virginia, Virginia, North Carolina, and South Carolina, and called for field trips and office work on the part of five or six technical members of the staff. A further diversion was a five weeks detail of Mr. Buell to the Washington Office to compile and edit for publication the new research manual of the Forest Service. In spite of all these diversions the Station can report more concrete evidences of work accomplished last year than in any previous year. These are listed at the beginning of our annual report and in the list of publications at the end. The latter contains 42 publications; Three U. S. Department of Agriculture technical bulletins, one state publication, (and another in which the Station participated), one U. S. Department of Agriculture Yearbook article, fifteen articles in technical journals, and twenty-two popular articles. Thirteen addresses were given.

Getting down to the investigative work of the Station, Colonel Pratt in his opening talk this morning emphasized the importance of making our research contribute to the "commercial side of forestry," which is commonly identified with the production of timber. Of course timber production is our original and most obvious incentive, but we should hold in mind, at the same time, the increasing use of forest land for many other purposes. When the Station was established we were concerned mostly with timber production. There was little thought at that time of game management, of soil erosion, or of the relation of forests to streamflow. Now, however, all these subjects are claiming much attention. In forest research we must visualize all these as factors in

the general problem of forest management, and we are therefore attempting to direct our research so as to establish coordination between the apparently diverse activities now being conducted at the Station so as to link up the results and make them generally applicable to the field of forest management in the broadest sense of the term. A single example of such coordination is the conduct of biological studies by Mr. Burleigh, consistent with the work on fire damage which is now being carried on at Bent Creek by Dr. Nelson and Mr. Sims. It is the intention of Mr. Burleigh to make studies to determine the effect of fire upon the number of small rodents which are residents of the forest and which are suspected of having a more or less important relation to forest reproduction. In other words, the forest is being studied as an organism made up not only of trees but of animals as well.

That covers all I wanted to say in general, and we can now proceed with the discussion of the individual investigative subjects.

Mr. Tyler: Beginning with that part of the program referring to management we first propose to take up the mountain region, concerning which of course we have the most information. On the subject of forest management, there are two members of the staff I wish to call upon. We will first hear from Mr. Barrett.

Mr. Barrett: The major problems in forest management as conceived by the Experiment Station deal with the treatment to improve the condition of the cut-over, burned, and otherwise ill-used forests, which make up the greater part of the forest areas. We are attempting to determine the best methods of cutting existing stands in order to obtain reproduction of better species and increase the growth of the trees left standing. Mr. Buell will discuss this work later.

Recently we have begun studies of the growth rate in the existing forest at the North Georgia working center. Three separate methods of obtaining this information are being used. First, extensive surveys to obtain general information on the relative growth rate of different species. Second, detailed studies on individual tracts to determine the annual growth per acre of different types. Third, establishment of permanent strips which will be remeasured at intervals to determine growth. This last method is slow but is the most accurate and will serve as a check on the technique used in the other methods.

During the past two years considerable data have been gathered on the extensive surveys. This has given us a general idea of the comparative rate at which some of the species grow and their probable sawlog rotation under certain limited conditions.

One of the major projects of the year was a detailed growth study of the forest lands of the Georgia Mountain Experiment Station. The area had been heavily cut for ties and saw timber in 1926-27 and our study showed the remaining stand to be growing at a rate of approximately 1/3 of a cord per acre per year. The forest type which seemed to produce best was the chestnut oak, black oak-scarlet oak type, which we found was producing slightly less than 1/2 a cord per acre per year.

Permanent growth strips were put through two areas in North Georgia. One of about two acres was established in a representative type on the Georgia Mountain Experiment Station woodlands. A more extensive project was begun in an unusually fine stand of second-growth yellow poplar in Soscbee Cove, Cherokee National Forest. Six permanent strips were run through this area, containing in all about 40 per cent of the total number of trees. This study gave us more detailed data with regard to the poplar than any work done so far. Past growth of poplar was found to have averaged approximately 402 feet per acre per year. The stand is now 57 years old and increment borings show some slowing down in growth rate. Of the last 20 years growth in diameter, breast high, 57 per cent was made during the decade 1912-21, and 43 per cent during the 10 years from 1922-31. At 57 years of age the pure poplar type contained slightly over 23,000 board feet per acre of poplar and about 500 board foot of other species.

Some work has been done with liberation cuttings. On quite extensive areas in Georgia an understory of white pine reproduction has become established under defective hardwoods. A series of five plots was established on the Cherokee National Forest as part of a study to determine the best and cheapest method of favoring the white pine by removing all or part of the competition produced by the hardwood over-story. On this area, as a side issue, we experimented with a poisoning tool devised by Mr. MacKinney. Studies were made of the time required to poison trees of various sizes as against girdling them with an axe. The work with white pine is, in part, a duplication of what was done at McFalls Creek, Natural Bridge National Forest, in 1928. The plots established there were later destroyed by fire.

A series of cleanings have been made by the Station at Looking Glass Rock to release yellow poplar from competition with chestnut sprouts. This was done before the chestnut blight became widespread and at the present time the chestnut sprouts on the check plot have succumbed so that the yellow poplar is doing very well in the check plots as well as in the plots from which the sprouts had been cut.

Recently we began to feel some demand for information on planting. County agents in North Georgia would like to see us experiment with planting walnut on a variety of soils in order to advise them with regard to desirable planting sites for this species. The state forest service and the Georgia Experiment Station have asked for information regarding the best species to plant on eroding old fields. Our funds

for planting work are very limited so that very little can be done now. Last year we did manage to establish a few small test plantings of white pine, both in old fields and as under planting.

Mr. Buell: Mr. Barrett has covered those sections of our work in management which deal with growth, and the treatment of reproduction which has already been established. I shall begin by telling you about our studies in the proper methods of cutting old stands in order to get suitable reproduction in sufficient quantities.

As a first step we have made extensive surveys of cut-over areas in the mountain region in order to learn the results of those past cuttings. Certain facts are already apparent. It is evident that reproduction is often adequate in quantity but lacking in quality. Quite often the ground is very largely occupied by reproduction of dogwood, sourwood, and black gum, and by sprouts instead of seedlings which are so much more likely to produce good timber trees.

The study has also shown that the cut-over lands often have left on them numerous hold-over trees which were unmerchantable at the time the cutting was made. In the great majority of cases the hold-overs are really less than worthless because they not only have no value in themselves, but hinder reproduction under them.

A second phase of this study of proper methods of cutting makes use of permanent sample plots which are cut-over experimentally. Since such a large proportion of our mountain hardwood lands have been tampered with a great deal of our work has been done in stands which were not producing to their full capacity. Consequently the problem is often one of converting these ragged stands into more profitable ones. One very obvious method of doing this is clear cutting. Some of the best stands of young growth in the region have followed clear cutting for charcoal or to clear land for cultivation or pasture.

At Bent Creek we began the study of clear cutting by removing all the timber on a six-acre tract of the chestnut-chestnut oak type. This work was done in 1931 and although no definite results can be given, it is already apparent that an abundant reproduction is going to result. Two other clear cut plots have been established at Blairsville.

Clear cutting is an extreme method of treatment. It is very rarely feasible economically and may even be undesirable silviculturally. It produces an even-aged stand in a region where we have many species, some of which may reach merchantable size in a relatively few years, while others must be allowed to grow for 100 or 150 years, in order to reach their greatest value.

We are therefore experimenting with various kinds of partial cutting. Usually the first step in the improvement of a stand is to remove the overmature and defective trees and those of the less desirable species, so as to benefit the better formed trees of the better species and provide light and growing space for reproduction. A cutting of this kind was made on the Berea forest in 1923, in a stand which had been cut over 33 years previously. Here it was possible to remove with profit the poor trees which were hindering the rest of the stand. Not only did the operation pay for itself, but it resulted in a splendid stand of new reproduction.

Cuttings in oak stands have been made at Edinburg, Va., and at Blairsville, Ga. Both these cuttings were made primarily to improve the stand, but again at Blairsville it was possible to sell the material removed at a slight profit.

On the Bent Creek forest we have started a series of different cuttings aimed to convert the ragged stand of hardwoods there into profitable stands for permanent management. One of this series is the clear cutting which I have already mentioned. Three types of partial cutting have also been made. The first of these removed trees to an approximate diameter limit of fourteen inches. The stand was marked according to the national forest practice, which leaves seed trees of the better species and removes all other trees which are merchantable for saw logs. This cutting will contrast with a silvicultural improvement cutting made in a neighboring stand. Here we did not confine ourselves to the removal of material that would pay its way out, but removed everything which we thought should be taken out to better the stand. All overmature and defective trees were cut as well as all trees of less desirable species. Both these cuttings were made by the Community Wood Yard of Asheville. The receipts were used to feed and cloth the unemployed of the city and no accurate costs for the operation are available.

The third area at Bent Creek, which has been cut this winter, is a stand of mixed pine and oak; shortleaf and pitch pine with white, black, and southern red oaks, on a rather dry site where the pines dominate the oaks. Dr. Schenck thought of a very clever scheme for handling that type of timber. He realized it would be difficult to convert it to pure pine because of the persistence of hardwoods. He cut the hardwoods for fuel on a 30-year rotation and let the pine grow for 90 or 120 years. The cutting we have made at Bent Creek is an attempt to begin such a system. What we have done is to cut out a large part of the hardwoods and leave a large part of the pine. The pine stand was thrifty, while the oaks under the stand of pine were defective and of slow growth.

Our studies of the natural replacement of blight-killed chestnut might be considered to be a third phase of this part of our management studies, since we are interested in the development of stands from which chestnut has disappeared due to natural causes. Mr. MacKinney has had charge of this work, which has been carried on at North Mountain and Hotel Mons, in Virginia, and at Bent Creek. I am sure he will be glad to answer any questions you may have to ask about it.

Another part of our work in management that I want to cover deals with thinnings. Thinnings are typically used in even-aged stands and since such stands are rare in the mountain hardwood region, our thinning operations have not been extensive.

At Cranberry, N. C., we have an even-aged stand of yellow poplar which resulted from a charcoal cutting 42 or 43 years ago. Here three different kinds of thinnings are being compared. At North Mountain, Virginia, there is a smaller stand of oak in which we have also made a thinning. On the Biltmore Estate, where there are rather extensive areas of plantings, we have made thinnings in planted white pine, shortleaf pine, and hard maple.

Still another part of our work in management deals with the causes of success or failure of reproduction. It is evident that this study is basic to all the others which I have mentioned. It is quite possible that we may find that one type of cutting may be followed by splendid reproduction at one time or in one locality, and the same type of cutting may be unsuccessful at another time or at another place, and yet we may be unable to give the reasons. We are starting rather slowly in this project and are beginning with our most important species, yellow poplar. Many questions have been raised about the reproduction of yellow poplar, one of the most usual of which is, why is it that when millions of yellow poplar seedlings start on a cut-over area so few of them ever grow into trees?

Mr. Abell is in charge of this work and although the project is still quite new, we are looking forward to very worth-while results from it.

Mr. Tyler: I am very much interested in what Mr. Buell has to say about yellow poplar reproduction. I have seen, and know that it is generally true, that almost everywhere within the territory presided over by our Experiment Station - of course I am referring to our mountain region, Mr. Camp - we do find very actively growing stands of yellow poplar. In the southwestern corner of Virginia, for example, on lands where large poplars were taken out 25 years or more ago and later oaks were cut, there was almost nothing to be seen on the ground, not a bare space even, where yellow poplar seedlings did not exist, but they never seemed to reach maturity. I can take you for a ride now

where I used to go horseback riding and show you hundreds of thousands of yellow poplar where once a heavy stand of oaks existed. The fact is yet to be proven whether those trees are going to go ahead and finally develop into really clear stands of yellow poplar.

Mr. Camp: We have some very good stands of yellow poplar in Virginia. In the Dismal Swamp some stands are cut over, getting 30 to 40 thousand board feet per acre.

Mr. Tyler: Now we come to that section of the work of the Station that has always interested me in a very material way because in the mountains of southwestern Virginia where we have coal it is necessary for us to keep timber growing or some of those days we are going to be out of timber. I refer to the work on fire protection. We would like to hear from Dr. Nelson.

Dr. Nelson: The plan of work for this project reads in part as follows: "In the mountain hardwood forest, the purpose is to determine the effects of fire upon the growth and quality of forest trees and reproduction, and upon soil and related site conditions, as a basis for developing methods for fire damage appraisal and as an aid in formulating protection policies and systems; and to gather information for use in restoring and managing fire damaged forest areas." At the present time the major emphasis is being placed on the study of the effect of fire upon growth and reproduction for the purpose of developing methods for fire damage appraisal.

It is unlikely that this region will ever be free from fire. There will always be "blow-up" years in which weather conditions are such that fires will occur in spite of anything that can be done. Because of the probability of future fire it is important to have a method of appraising fire damage.

Appraisal is necessary for the compiling of loss records, for settling of damage claims in court, for inducing legislative and public support, and for collecting funds for fire control; and since no satisfactory methods of appraisal have yet been devised, it is the task of research to supply them.

In the past most emphasis was placed on the study of fire weather and the effect of fire on soil. The several reports published by the Station have defined the periods of greatest hazard for the Southern Appalachians. Methods for studying the effect of fire on forest soils have been devised from which it appears that the greatest damage to soil is caused by the reduction and change in the organic layers which profoundly affects both the chemical and physical character of the soil. Detailed examination of several hundred acres of burned forest have shown the ratio which exists between diameter of trees and mortality after fire. A number of observational plots in burned areas have been established chiefly for the purpose of learning continued mortality, and an experimentally burned plot in a pine-oak stand has been established.

During the past year analysis of the data on basal damage obtained during the preceding field season has been completed. A set of curves for four important species of oak and for yellow poplar have been prepared whereby it is possible to predict with considerable accuracy the size of wound from rapid and simple measurements of the amount of charred bark at the bases of trees. Some information as to the relative susceptibility of these species to fire has also been obtained.

Growth figures from plots established in a shortleaf-pitch pine area, show a very striking difference between a burned and unburned stand. Considering the basal area before the fire as 100 per cent on both plots, six years after the fire the basal area of the dominant and codominant trees on the unburned plot had increased by 20 per cent, but on the burned plot it had decreased by 10 per cent. In the smaller trees on the unburned plot there was a reduction of basal area of only 10 per cent, probably a reasonable amount to be expected in crowded stands. However, on the burned plot the decrease amounted to 50 per cent. In other words, on the burned area, six years after the fire, not only had the growth during the six years been off-set by the continued dropping out of trees, but there was actually less wood on the burned area, amounting to approximately 10 per cent in the larger sizes and 50 per cent in the smaller.

It is information such as this that we propose to get for mountain hardwood forests. We have therefore established a plot at Bent Creek of about 20 acres, with an adequate check, which will be burned this coming fall or spring. We have divided these areas into 1/10 acre units so that similar units can be grouped together and desired comparisons of groupings made. We will take the necessary measurements on the trees before the fire, and then burn over the experimental area. If our control and experimental areas are similar, then any difference after burning can be ascribed to the fire. We expect some mortality of trees and some reduction of growth in the remainder. How much, we do not know, and that is precisely the purpose of the experiment. The area is sufficiently large so that we can hope for a fire similar in intensity to the usual uncontrolled burn. Of course a single plot, even though fairly large, cannot be expected to answer all questions for a region as varied in types, sites, and condition classes as is the Southern Appalachian. By establishing five or six plots, however, which include the extremes of good and bad stands, and with several covering the intermediate stands, possibly something can be accomplished by way of establishing methods of damage appraisal.

I have attempted to emphasize that at the present time fire damage appraisal is the main objective of the project. There are, however, several other phases which deserve attention and which may eventually prove to be of greater value than damage appraisal. Since they do not bear directly on the main question, they have been designated as minor projects. They will be discussed by my associate Mr. Sims.

Mr. Tyler: May we now hear from Mr. Sims.

Mr. Sims: Dr. Nelson has indicated that the studies I am about to discuss are considered of secondary importance in the project dealing with fire damage. I should like to bring out, a little more clearly than does the annual report, the relationship between the minor studies and the major one and the general reasons which lead us to consider them important enough to warrant the expenditure of effort in their solution.

Certain observations and conclusions can be obtained from sample plot studies. These observations and conclusions, however, are bound to be very general. Thus, while it is possible to ascertain from experimentally burned plots the sum total of the effects of site reduction, root, bole, and crown injury, the effects of any single one of these forms of injury can be segregated only by controlled experiments in which each form of injury is tested separately. Similarly our study of the relation between external discoloration and basal wounds gives some information on the relative "fire proofness" of the different species studied, but fails to establish the relative importance of the factors involved in resistance to fire injury, such as insulating properties of bark and thermal death point of the cambium.

As has been said, we have little expectation that these studies will contribute directly to the method of damage appraisal, but rather we look to them to answer questions involved in the latter part of the purpose of the project as given, namely, "to determine the effects of fire as an aid in formulating protection policies and systems; and to gather information for use in restoring and managing fire damaged forest areas." It is likely that the better one understands and knows the reactions of trees to such an influence as fire, the better he should be able to manage a forest in which fire is or may be a factor.

The observational side of the project has already indicated the desirability of the following studies and it is expected that others will be met with from time to time. These studies, we hope, will explain the "why" of the results observed on the plot. From the standpoint of damage appraisal, it is probably satisfactory to know merely what happens; we should like to go farther in our investigations, however, and be able to give the reasons underlying the observed results.

Although the following list is already long enough to keep several men busy for some time we are planning to take up the studies in such time as is left after the major phase of the project has been cared for.

During the coming year we intend to work on the insulating properties of bark. This is a follow up study resulting from the limitations of the data taken in the basal wounding study. Equipment for the insulation work is now set up at Bent Creek and tomorrow we plan to demonstrate

the technique to be used. The results of this study, together with those from a study of the thermal death point of the cambium, will give a pretty definite picture of the relative susceptibility of various species. The results will, moreover, be free of the uncertainties inherent in field observations, because controlled temperatures will be used.

Two other studies related to basal wounding have been planned for the future: (1) rate of healing of fire wounds, and (2) their effect on the rate and path of sap movement. The first of these has a distinct practical application since rate of healing affects the time a wound is open to infection by fungi. The second is more in the nature of an experiment in physiology.

The earlier established plots have shown that serious reductions in growth occur following some fires. It is desirable from an academic as well as from a practical standpoint to find out the actual and relative importance of the forms of injury associated with or bearing on growth. One of the most obvious of these is reduction of crown. On burned areas, however, the effect of crown reduction is so intimately mixed with the effects of reduction of site quality, root injury, and bole injury, that separation is practically impossible. Investigations of the effects of each form of injury separately calls for a special technique for each. Crown reduction or bole wounding are relatively easy to study, but root and site injury present special problems of procedure which have not as yet been adequately developed.

Very little has been done in this region on the rôle of fire in changing type, although elsewhere it has been recognized that burning is responsible for profound changes in the composition of the forest. Reasoning by analogy it seems likely that similar conclusions will be reached here. The magnitude and direction of the changes need to be worked out, particularly for repeated fires, so that the timberland owner can know what to expect in the way of types following single and repeated fires. Some of the phases of a study dealing with the effects of fire on type would take up the relation of fire to rooting habit and to root-suckering as a method of regeneration. Preliminary observations indicate that root-suckering following fire may be an important means of increasing the proportion of some less desirable species in the stand.

In the Southern Appalachians the composition of the forest ("forest type") seems to be closely linked with fertility of site, which in turn is partially dependent on rate and character of litter decomposition. For these reasons we have started a small project dealing with litter deposition and accumulation and plan to carry it on on the major plots of the project.

I have not intended to convey the idea that we consider the problems I have outlined as the only ones requiring attention. They will, however, give you an idea of the nature of the work contemplated. Although all the problems are related to the main phase, each is susceptible to individual treatment and we propose to take them up one at a time, completing each before the next is begun.

Mr. Tyler: We have the pleasure this year of having with us, for the first time, a man who can make a report on forest fire weather forecasts actually studied here in person alongside of our Experiment Station. We are delighted to welcome Mr. Pierce, and I know of nothing that has been of greater satisfaction and pleasure to me than to have this work begun. I think we all feel that in the future this work is going to be of great aid to forest fire prevention in our section.

Mr. Pierce: We all feel that this matter of forest fire prevention is of great importance from the standpoint of maintenance of the stand as well as many other factors. We all realize, of course, that the weather has a great deal to do with the occurrence of fires. Whether or not they will start, and once started, their rate of spread are questions upon which the weather has a direct bearing. The most important elements, of course, are rainfall, temperature, humidity, wind direction and wind velocity. Those are the elements from which the Weather Bureau makes its determinations throughout the whole country. If the fire fighters and those who are directing their activities can know what sort of weather conditions will be encountered from day to day, it will be of considerable benefit to them in controlling their fire fighting activities.

In recognition of this need on the part of the foresters, the Weather Bureau has established what is called the Fire Weather Forecast Service. This service has been in operation for quite a number of years in different sections of the country. It was inaugurated first in the western states - Oregon, Washington, Idaho, California, and a number of others, and later in the northeast - the Lakes Region, and parts of New England. Recently there has been a great demand for an extension of this service into the Appalachian Region, and the Weather Bureau has finally received appropriations for the starting of this work. They have sent me here from Chicago to take charge of the work, and since my arrival in March I have been studying the service needs in this section - going into the distribution of rainfall and wind as related to forest fires, and attempting to work up a form of fire weather observational report upon which to base the forecasts. I have done this as thoroughly as possible with the time available, and have arrived at conclusions upon which I intend to base the service for this region.

It is well known that in this section we have many peculiarities which are not found in any other section of the country. Our fire season extends pretty well up into the winter, and sometimes throughout the winter. It may cover a large part of the year, and no month may be absolutely free from fires. This is, of course, entirely different from what we have in many other sections of the country. Then we are out of the normal storm paths which extend in general across Montana, close to Chicago, and northeastward across New England. This section is sufficiently far south, so that we do not get much rain from storms which follow this path. Consequently the rainfall which we do get must come from storms originating in the southwest or the southeast. On account of these peculiarities, it is impossible for me to take some other fire weather service as a pattern, and apply those rules and procedures in this section. I have to study conditions here as best I can and determine what sort of service will be most effective here. I have arrived at such a determination, and for the last month have been trying to get the observing stations lined up.

This is a difficult job because the observing has to be done on a cooperative basis, and observers have to serve without pay. It would be easy to get reliable observers if we could pay them, but this is not possible. Naturally, too, the records must be taken by reliable people in order to be of the most value.

Records which will be taken include the temperature, humidity, wind direction, velocity, state of weather and precipitation; and also a statement as to the conditions of the litter with respect to burnability. This last is very necessary, for upon reports of the fire hazard existing, will be based the decisions as to whether or not warnings will be sent out. These records will be kept throughout the year so far as possible, and will be sent to Asheville at the end of each month, for records purposes. During the fire season, the reports will be telegraphed to Asheville at 8 a.m., where they will be charged in connection with the regular map which is made up at the Weather Bureau.

The forecasts which will be issued, will cover the wind direction and velocity, temperature, humidity, rainfall, and possibly a prediction as to the fire hazard. Fire weather forecasters are authorized to issue so-called fire hazard forecasts, but that would, of course have to be based upon experience. One not familiar with conditions should not make fire hazard forecasts. The recording, as I stated, would go on throughout the year, and the records will be sent in to me in Asheville. The reporting by telegram will continue only through the fire season. Accordingly we have set the season of reporting as extending from the middle of October to the middle of December, and again from the middle of February to the middle of May. We expect these dates to cover it satisfactorily, but if necessary, and upon occasions requiring it, we will extend the reporting and forecasting season either backwards or forwards to accommodate the individualities of the season. This will be done, of course, with the advice of the Forest Service.

Forecasts will be sent out only when conditions warrant. If we have a heavy rain during the night over the whole region, there will be no fire warning issued. If conditions warrant it, however, the forecast will be sent out and will cover a period of from 24 to 36 hours. Ordinarily they will extend up to 36 hours, though there is a possibility of extending it farther - possibly to 48 hours in settled weather.

I am thoroughly convinced of the value of a fire weather warning service, since it has been so successful in other parts of the country. I am glad to have been charged with the responsibility of extending it into the Southern Appalachian region.

Mr. Tyler: We had planned at this point in the program to have some comment or discussion on matters that have already been presented. In order to try and make sure that we were going to have somebody here to lead these discussions we selected, among a number of others, Mr. Robertson and Mr. Gennett to do this. However, neither one is present. Representing another section of the country we had also asked Mr. Raine of the Meadow River Lumber Company to lead the discussion. On the 15th Mr. Raine, in a letter to me, expressed his regret at not being able to be here today. Consequently we are left without leaders in this line. I am wondering whether, in view of the fact that Mr. Damtoft is here, representing Mr. Robertson, he will not have a word to say to us on the subject.

Mr. Damtoft: I deem it a privilege to be here today as proxy to Mr. Robertson. He informed me, only yesterday, he had sent his regrets to the secretary and requested that I express to the members of the Council his regret at not being among you today.

With regard to the management and progress of the Station, it seems to me that this subject is of particular interest to those who are concerned with cut-over lands and with the problems of securing good reproduction of yellow poplar and pine and the associated species of these mountains. Also the problem of what will take the place of the rapidly disappearing chestnut is of particular importance. In obtaining pulpwood we have been impressed during the past few years by the importance of the farm lands. Today you might say that 100 per cent of the pulpwood requirements of the mill are being met from these sources. The larger sawmills in this section have been cut out and the smaller ones are operating only on part time, so we are naturally looking to these farm lands for a good supply. This situation is of course due to the extension of good roads back into the mountains. In part, also, it is due to the present state of depression. Farmers west of Canton find their wood products of great value. Wherever there are good trees they know they are marketable and will bring in cash. Indeed, were it not for the forest products, conditions would be far more serious in our section than they are.

Undoubtedly you have made the same observations that I have in traveling over our highways and roads, that wherever there is a small clump of trees, they have been and are being marketed. Down in the Nantahala Gorge, in Graham County, small poles that only a few years ago were absolutely inaccessible are being cut and marketed right along. As you drive along today you will find little piles of wood along the road; and the various trucks come along, pick up a load, and carry it to the mills.

Yellow poplar and pine are important woods in this section. The farmers away from the valleys in many cases have a considerable acreage of pine producing land, and in the mountains, as you know, the pine produces rapidly. Then the farm lands along the valleys grow yellow poplar. Who has not been impressed with the density of reproduction in our part of the country? The important question is how it shall be handled. It seems that this question is one of the most important that is being investigated by the Station, particularly with reference to yellow poplar. The solution of the problem of how to secure the best stand of yellow poplar will be of value to all farmers in this section. Of course the question of fire has been with us a long, long, time and it is evident that it is one of the very greatest importance.

When Mr. Robertson found out yesterday that he could not be here he asked me to tell you that he had reviewed the Station's projects and felt that they were all good.

I have undertaken to mention points which seem of importance to me and to convey to the Council Mr. Robertson's impression that all of the management projects are very worth while.

Mr. Tyler: We are very much obliged indeed to Mr. Damtoft. We are now ready to throw the question open for remarks or questions from any members of the Council or others present.

I should like to ask Mr. Roberts, who is a new member of our Council from Richwood, W. Va., to say a word to us.

Mr. Roberts: I have been particularly interested in what Mr. Damtoft said in regard to our highway systems and their effect upon the farm forests. In the State of West Virginia, up near Richwood, we own a tract of over 200,000 acres which we have tried to put under sustained yield management. Half of it is in spruce and the other half mixed hardwoods. We have no highways up that way and are getting none, and we have to depend entirely upon railroads, which as you know is an expensive proposition. There is not a single highway through that 200,000 acres of land, and we have found in the last three or four years that we can buy logs 50 miles away from our mill, coming from other persons' land, cheaper than we can bring our own logs in to the mill. We have practically had to give up the idea of sustained yield management. First we had to figure on a fifty year cutting cycle and a 100 year rotation. We had to wait until our wood grew before we could afford to build a railroad to carry it. We must have 4,000 board feet per acre to make a railroad pay.

The roads and highways in our State, when built, instead of following the valleys where it would be possible to bring logs from both sides of the valley to the main highways, were all laid out to follow the tops of the ridges, for scenic beauty, and for that reason we cannot cut any sawlogs to bring over these highways. Some of these ridges were more or less flat and ^{some} are practically bare. Evidently the Highway Commission has at last realized that people driving through from the middle western states, while they want scenery, object to climbing these mountains then dropping right down again. In our particular section, in the last few years, they have begun to change their method of laying roads, and it is going to revolutionize the lumber business in our section. I would make a guess that we can keep on operating for the next ten years and not cut a single stick from our land.

This depression has probably had some effect also. When we started to make out our sustained yield program we had to work on the theory that one section of the tract had to have 50 years growth before we could go back on it. We could have to have 4,000 board feet an acre before we could make a railroad pay. With new roads up the valleys and river bottoms, with 40 miles through our land, we are positive that we can work back to our old sustained yield proposition and use that valley always. I cannot say as much though for the rest of the lands. In fact, if we have no relief from taxes we may have to depend forever on the farmers for logs. At Rainelle, and on the West Virginia Pulp and Paper Company lands they have stopped cutting entirely and are having logs brought to them and sold at their door.

I have hardly touched on the subject that has been brought up this morning because I felt that this has certainly changed the whole industry in my part of West Virginia. I have been talking with several other lumbermen who think likewise. I feel that a system of good roads, in time to come, will change matters so that we are not going to depend upon railroad logging. Most of us will be able to work on a sustained yield management plan, very different from what we have had in the past.

Mr. Tyler: Mr. Roberts has referred to the ridge-top highways. It reminds me of an experience I had once. A man once said to me: "Mr. Tyler, I bet you cannot guess what I have been doing." I did not try to guess. "I have been ordering a new book I found which has the title 'Scenic location of railroads.' I just wanted to see what some darn fool could find to say on that subject."

I think, like Mr. Roberts, that roads should be built along the valleys and streams. Many years ago I lived in Bristol, Tenn., and then, about 26 years ago, there was not even a trace of macadam road leading into that town from anywhere, either Tennessee or Virginia. It has certainly made a big difference in that part of the country, since now all logs are being carried in on trucks.

Mr. Tilghman: Mr. Chairman, I would like to say a word in regard to Mr. Roberts' statement about the highways. Why not have your own roads? Of course I am not presuming to tell Mr. Roberts how to run his business, but it seems that with a tract of 200,000 acres you should have your own system of roads, thereby making sustained yield, replanting, selective cutting, all profitable in your forest management scheme.

I believe that research should aim to give the farmer in concise, plain English and form exactly what he needs today to manage his farm woods. That is the question, or the demand, before the country today. It is absolutely necessary for the future utilization of the forest. We should be able to put into the hands of any farmer a boiled down bulletin to go by in his forestry farming.

Mr. Tyler: Has anyone anything further to say about these mountain projects?

Mr. Mattoon: I appreciate very much the opportunity to come up here as a guest. In listening to Mr. Barrett and Mr. Buell on their discussion of management, one or two things have come into my mind. The projects we have heard about related largely to the treatment of trees. They related a good deal to thinning in young stands. What about the treatment of the reproduction after it has been established on the ground? In the national forests we are going ahead with a program of a survey of areas that have been cut over under national forest administration. We are examining these areas and making a detailed count and tallies on sample areas. We find, in reviewing the work we have done so far, that in a great many instances we are not getting what we want or the amounts we want, and we are beginning to think there is something wrong with our methods. We are going still farther and are asking the timber purchasers for funds to treat these areas so as to be able to put them in the best possible shape. We have not gone very far with it as yet, but as I see it, and under our requirements at present, this field offers considerable opportunity for the Experiment Station to cooperate with the national forests to find out what is actually taking place on the ground as the work is going on. To find out just what is the cause for these yellow poplar seedlings dying out after coming in thick on an area, has been mentioned as a project of the Station. We are having the same experience, and I wonder if it is not due to the treatment. There, I believe, is a study in connection with management.

I bring up this work we are doing on the national forests as a possible activity for the Experiment Station. Whatever records we have are available to the Station. I would like very much to see the Station work with us and make recommendations as time goes on as to the treatment that should be given these areas.

Mr. Tyler: If there is no further discussion of the mountain region, I think that we had best adjourn for lunch. I understand that lunch will be served at 12:45 and it is now 12:30. We will adjourn until 1:45 p.m.

Mooting called to order at 2:10 p.m.

Mr. Tyler: We have concluded the discussion of forest management and protection so far as the mountain region is concerned, and we can now take up these subjects for the Coastal Plain. In opening up that part of the program we would like to hear from Mr. MacKinney.

Mr. MacKinney: Those of you who have attended Council meetings during the last few years have several times heard Dr. Korstian and myself stress the advantages of the Atlantic Coastal Plain portion of our territory as a timber producing region. These advantages preclude excellent climatic and soil conditions, fast growing species (particularly loblolly pine), a topography that lends itself to unusual ease of logging, and ease of access to the largest lumber markets in the country. Even under present conditions of inadequate fire protection and unrestricted cutting timber is growing well in many portions of this territory. Undoubtedly the timber lands would produce far better crops if accorded the treatment which, in the light of our present knowledge is even reasonable, not to say desirable. If, going farther, we knew and could apply the most desirable practices undoubtedly production would be much greater. Our task then, as a research organization, becomes one of determining how to treat present and future stands in order to get the maximum production of the kind and quality of desired timber in the shortest time. To find this out, the answers to many problems must be obtained. These answers will differ at least in some respects for the several species with which we are concerned, to say nothing of the many sites on which they are growing or should grow.

The work of the Station on the Coastal Plain started in 1925, with a study of southern white cedar, the results of which have recently been published as U. S. D. A. Technical Bulletin No. 251. Work then turned mainly to loblolly pine, first, to obtain, by surveys of burned and unburned cut-over loblolly pine stands, information on the establishment and development of reproduction, following cutting and fire, and to ascertain how fast trees grow when left following partial cutting. This work was interrupted by an unusual opportunity to cooperate with the Forest Products Laboratory in a combined study of silvicultural and economic cutting practices in loblolly pine stands in three different localities. During the past two years three groups of sample plots have been established in this work. Results of the economic phases of the work have been partially summarized in Bulletin No. 43 of the Virginia State Forest Service. The complete summary will be compared for publication during the coming year. Many years, however, will be necessary to accumulate the data on the establishment, growth, and development of the reproduction following these cuttings. The plots will be re-examined periodically until such time as results warrant preparation of publications.

A supplementary study on one of those groups of plots gave very interesting information on the relative costs and efficiency of several methods of removing undesirable trees from forest stands. These results, as included in a recent paper in the Journal of Forestry, show poisoning to be the cheapest and most efficient method of removing hardwood competition in the forest stand studied. Likewise poisoning was most efficient in preventing sprouting of the hardwoods treated.

During the coming year the survey of cut-over areas will be continued and the results compiled. Preliminary results indicate that a number of questions regarding the effects of fire on loblolly pine forests are of immediate importance and deserve consideration.

The past work on the effects of fire has been chiefly on one set of plots. These plots, inherited from the Southern Station, are mainly in the longleaf pine type. An accidental fire last December, which burned half of the check plots, necessitated changes in the plans for this group of plots, including the establishment of a new check area nearby. This accidental fire, though lamentable, will give us quite interesting information within the next few years. It seems desirable, however, not to scatter our limited funds for Coastal Plain work over too wide a field, and we plan to do little more work on longleaf pine except to continue the remeasurements of plots.

It does seem desirable to plan for further work on the effects of fire on loblolly pine. At present we know that under most conditions loblolly pine reproduction up to two inches in diameter will not withstand an uncontrolled fire. There are, however, many questions which arise concerning the mortality of larger trees when exposed to fire of different intensities, the reduction of rate of growth following occasional and periodic fires, as well as the possible beneficial uses of fire following cuttings, giving better conditions for germination and establishment of seedlings.

We feel that the importance of the Coastal Plain portion of our territory as a timber producing region warrants expansion of our research efforts therein. The impossibility of such expansion under present conditions is fully realized. There is, however, one outstanding need which must be one of the first to be considered in our plan of research for the Coastal Plain; this is the need for an experimental forest. Realizing that all fundamental research requires the establishment of sample plots over which the research organization has permanent and entire control, including assurance of protection from fire and unrestricted cutting, it is easily understood that no program can be carried on without an experimental forest. Even with the very small amount of work which we are now doing in the Coastal Plain, we find it impossible, on lands over which we do not have full control, to follow many of the leads which we think it very necessary to consider. Accordingly, one of the first things which we must obtain, either through purchase or gift, will be a tract of at least 1,000 acres on which we can establish sample plots with the assurance of complete protection and long-time ownership.

Mr. Tyler: I think it is most fitting that we should now hear from a man who is closely associated with the work in the Coastal Plain section. I would like to call on Mr. Camp to lead this discussion of coastal projects.

Mr. Camp: I have followed with a great deal of interest the experiments made down in our section. I have enjoyed working with Mr. MacKinney and his party and seeing the work they were doing there. Of course the people of the Tidewater section have been and will be benefited by the results of this work. We feel we have a large field, just as important as the mountain region, and we do feel the need of work to be done down there.

I am very much interested in this little book, Bulletin 43 of the Virginia State Forest Service. If you will refer to it you will find the results of experiments in the Coastal Plain section which, I am sure, will open your eyes to things you never knew about in that section. The Forest Service party was very thorough in its work there and we are in hopes of getting great benefit from it, showing us how to care for our forests.

Several years ago our Company started experiments in selective cutting. We have not gone far enough to have results yet, but we do feel encouraged. The coastal pine is a very rapid growing species and we feel we should get a good second cut in 30 or 40 years. That's a long time to wait, and most lumbermen will be out of business and then most of them do not have enough money to carry on these cuttings.

One thing comes to my mind now. That is the protection of forests from fire. Most lumbermen, in theory, believe that keeping fire out of the forest is the best practice. After looking at it for a long, long time I wonder if that is right. When we leave forests without fire for 20 years we have such litter on the ground and such heavy underbrush that in dry seasons the forest becomes most inflammable. When you have a fire after the 15th of March the mortality of the pines is alarming. I believe that if we could control the burning of the Coastal Plain - say burn it over once every five years, when the ground is wet and there is very little wind - we would get better results than if we kept fire out entirely.

Last year our Company cut over four or five thousand acres of land which had not been burned for several years. Some farmer started a fire, and from four to five miles the country was swept clean. It was not only a ground fire but a crown fire. If that land had been burned under control last winter, I don't think the fire ever would have got started. I think that is really the theory of most of the foresters. Some of them won't admit it, and they will never allow it to get out for publication. I can of course see their reasons. It would never do to tell some farmers and people living in the woods that fire is a good thing; certainly not until you teach them the proper time and conditions to have that controlled burning.

In Virginia we tried to prevent fires entirely. Through North Carolina we have some fires and farther south we have more, until in South Carolina they burn every year. Last fall it was very dry and in South Carolina the swamps that had not been burned over for 20 or 30 years had everything burned in them up to trees 20 or 30 inches in diameter. Of course you cannot ordinarily burn those swamps like that. They are usually so wet the fire would not go very far. But last fall's fires certainly furnished an example of what a long period of no fire will do when fires finally do come.

Mr. Buell was talking this morning about clear cutting. Do you mean by that Mr. Buell, that we should cut clear an area on which there are young, thrifty trees?

Mr. Buell: I was speaking of hardwoods at that time, and especially of decrepit stands in which there were very few young, thrifty trees. This cutting at Bent Creek was merely a silvicultural cutting and not intended for commercial practice. It was done from a silvicultural point of view and from that point is of interest to us.

Mr. Camp: But where you have good stands of pine from 14 inches and up, which is good merchantable size, would you advocate cutting it clear? My practice and experience has not taught that. For instance, in South Carolina I have advocated that we leave two or three seed trees per acre to reseed the area. Of course you must teach the landowners to keep fire out. I hope, at least, they will one day learn not to cut all the trees as in Mississippi and Alabama, then they will not have to go back and reseed the land to make seed trees.

I think, following up Mr. MacKinney's work, we should make an investigative study in the Coastal region as in the mountains, as to why, when you cut over one area you get a regrowth of pine, and within a half mile you get a regrowth of scrub oaks. We want to know what we are getting and what we are going to get when we cut the forest. Down in our country when we cut longleaf we are apt to get loblolly, and when we cut loblolly we don't know what we are going to get.

Mr. Tyler: We have with us a member of this Council who has had vast experience in the manufacture of lumber in the Coastal Plain, and I am going to ask Mr. Tilghman to speak. I am going to give him the privilege, also, of calling on Mr. Smith, State Forester of South Carolina.

Mr. Tilghman: The most I can say, I guess, is to back up Mr. Camp in his statement. We have submitted a resolution which we hope will receive favorable action. It is just as Mr. Camp says: the Coastal Plain section is a vast territory and we really know very little about it. We have quite a bit of information on the pine, which we have obtained through the Southern Station. While their studies have, for

the most part, been made farther south, the character of the forest is similar and the information supplied is of great help to us. What we need is more information on our own territory, and particularly on the hardwoods.

You can realize the importance of such information if you think of the number of rivers that leave those mountains and go on to the ocean; every one of them is lined with hardwood timber, and they have been cut into so much the last few years that we are beginning to have idle hardwood land on our hands and no one seems to have any idea of what its value is and what its future possibilities are. We need studies on the Coastal Plain just as much as in the mountains. We understand the situation with regard to the Station and that the work outlined must be carried on, but still we believe that at least one full-time man should be put in the Coastal Plain section, if some of the work in the mountains must suffer a little. I am sure that Mr. Frothingham can work out some plan whereby the work here will not really suffer and we can get some practical information as to the areas, how to handle them, and how to make them commercially profitable to the owners so that they can pay the taxes. If these studies could be started promptly, valuable information might become available soon enough to be applied on those lands that have not yet been cut, so that the cutting could be done in such a way as not to lower the value of those lands when the timber is taken out. It seems we are entitled to some help down there. This Council represents some five or six states and South Carolina is one of those states. Very little work has been done there and possibly the work, if done, would apply to several states - North and South Carolina and Georgia. I have no idea as to the size of this hardwood area, but if you will keep in mind some of these rivers, draining from the mountains to the ocean, you can see there is a very great area.

Mr. Smith, our State Forester from South Carolina, is here and he will tell you something more about it.

Mr. Smith: Mr. Camp touched upon a broad subject when he spoke of light burning. I was indeed very sorry to hear that matter brought up. I have heard a great deal about it since being in South Carolina and am sort of getting used to it now, but I hated to hear it here.

The Station is conducting experiments upon the damage done by fire. The attitude of foresters has been, as you know, that you might lose the whole of a limited area and still not suffer a loss so great or so bad as that which might result from a light fire on a whole area.

I have one suggestion I would like to offer for research work in South Carolina. They are saying down there now in South Carolina that it is a pity that this depression had to come now when no one had any money. By this same token I think it is a pity this should occur at a time when we are not able to give absolute facts which the people desire.

We appreciate the work being done by the Station. We have had the most whole-hearted cooperation from all the men connected with it.

We are conducting, at the present time, a little work in vocational agricultural schools. For each county in the State of South Carolina we have a school with a ten-acre demonstration forest. Upon these ten-acre demonstration forests are at least three distinct types of work. One, a fire plot in which a $\frac{1}{4}$ acre plot is burned each year; second, a quarter acre tract not burned; and third, thinnings and control plots in young pines. I was at first afraid this work might be too technical to arouse much popular interest, but these demonstrations have attracted a great deal of interest. Those boys have gone ahead and thinned their own plots, and in some cases the farmers around have come over and given a hand in the work. These plots have caused us to get an increased interest in forestry. We told the boys how to thin trees and now we have neither the time nor the money to demonstrate and we do not know how to advise these schools further. We must depend on the Station for information. Therefore, we feel that the Coastal Plain does need help in this and many other ways. Our men are not research men. The Coastal Plain country needs the help of other organizations and all that it can possibly get. When I speak of the Coastal Plain section, I refer particularly to South Carolina.

Mr. Frothingham: I would like to discuss two or three of the things that have been brought up in regard to the Station's work on the Coastal Plain. We have, for years, wanted to develop more in the Coastal Plain and for years we have been limited by the policy under which this Station has had to act. You will remember that the Research Council has several times recommended by resolution, an increase of work in the Coastal Plain, and that was entirely in keeping with our desires. We believe that the Coastal Plain is deserving of even more activity than the committee on resolutions ~~today~~ is proposing to suggest. We are already committed to the time of one man on the Coastal Plain, but the time of one man is inadequate. The greatest impediment, however, is that, as Mr. MacKinney has stated, we have no place to work on the Coastal Plain where the work will be completely under the control of the Station.

Now it seems to me that the thing to do is to go straight after this matter of increased work on the Coastal Plain. Right now our limited resources seem to require a choice as to whether the Station shall develop its investigations along the lines of forest management at the expense of fire protection studies, or vice versa. Mr. MacKinney and I are inclined to believe that of these two alternatives we should devote our time to protection, which we have fairly well started, rather than to management. With our financial limitations I think a promising line is that suggested by Mr. Camp, to test out thoroughly the question of light burning, by experiments to determine the effect on growth of light burning at five year or possibly three year intervals. The prejudice of most foresters is in favor of total protection, while that of some lumbermen and timberland owners is for light burning; but we cannot regard prejudices in investigative work.

Our Washington Office recognizes the importance of the Coastal Plain work and they have set up as an ideal, and one which they expect to reach, funds which when appropriated will permit a good volume of Coastal Plain work. There is no telling when that time will come, but we want to be prepared when it does come and the best way is to have an experimental forest assured so that when work is begun it can go on uninterrupted.

We are thoroughly in accord with Mr. Tilghman as to doing work in the bottomland hardwoods, in which fire protection studies may probably be subordinated to studies of growth and reproduction.

This is the situation that we are now facing and I just wanted to say that we are anxious to develop rapidly along those lines and it is the Council which can help us more than anything else in attaining that goal.

Mr. Damtoft: May I ask a question? How far north does the Southern Station's work extend?

Mr. Frothingham: The Southern Station is performing work throughout the Gulf States coastal region to and including Georgia. So far as fire damage work is concerned, the Southern Station has run into a difficult problem and a controversy with particular reference to the effect of fire on longleaf pine reproduction. It would be desirable if we could do some of that work in the longleaf pine of South Carolina; as previously stated we already have an experiment in longleaf and loblolly pines mixed, at Lanes. Our big problem, however, is in loblolly pine. It is the one species of pine we should center our work upon in the Coastal Plain section, since the Southern Station is not doing very much with loblolly.

Mr. Tylor: I am reminded of a paper by Mr. Greer of Mississippi that recently appeared in the magazine, American Forests, the title of which was "The Forest That Fire Made." I also remember that in a conversation I had with Mr. Chapman at the Council meeting last year he said that some fire is necessary for longleaf pine, that a certain amount of burn is needed for the good reproduction of longleaf pine forests. He added that he might be considered a heretic by some people for making such a statement. However, there is no question in my mind about the effects of fire on mountain hardwoods. I have followed that part of the thing far enough to be convinced that while there may be some things in the forest you want to get rid of, fire is not the instrument to do it with, or the instrument you want to use to get rid of it. You may want to get rid of slash, but it is a pretty dangerous experiment to attempt it with fire. So far as longleaf pine is concerned, however, it may work; as to whether controlled burning can be helpful in the reproduction of longleaf pine, I would not pretend to say. I have great respect for Dr. Chapman's opinions, and I don't believe he would make such a statement without believing it to be true. I read carefully the article "The Forest That Fire Made," and unless I am mistaken, it was published with a letter of apology by the editor, saying that the American

Forestry Association was not responsible for any thought that it contained.

We have one member of the Council here today whom we do not have the privilege of having often, and we would like to hear from Dr. Hutchins, President of Berea College. We would like to hear about anything at all that Dr. Hutchins cares to tell us, about his forest, or his school activities.

Dr. Hutchins: I can talk to you about Berea, but with reference to the forest I shall have to refer you to Mr. Frothingham, who has cooperated with us from time to time. We have about five or six thousand acres of forest land within about two to five miles of school. We are cutting from it approximately 150,000 board feet of lumber each year. We are cutting under the auspices of Mr. Frothingham and his associates. The exact value of the forest I do not know, but we are using the wood for our own constructions about the college.

In the college we have some 1575 students, of whom 110 are from West Virginia, 100 from Virginia, 75 from Tennessee, 75 from North Carolina, 25 each from Alabama, Georgia, and South Carolina. Approximately 90 per cent of those students are from the mountains. We are trying to make educational facilities as cheap as possible for them.

We are making very nice furniture from the walnut taken out of our mountain boundaries near Berea. We have to pay the boys, of course, who work in our wood-working industries, so we try to make commodities which will sell and pay for themselves, at least. We have had Colonel Graves and others down there to make a study of the forest from the standpoint of utilization of the wood which we have on our forest. If we can find some small article or articles of household use that we can manufacture and set our boys to work from two to four hours a day, and not run into a hole, we would be glad to make it. Therefore, if any of you know of such a product or should run across any such thing, we would certainly be glad to know of it.

Many of our boys come without any money at all. Some do not even have stamps to pay for sending their letters home. We have to help in every possible way. If you know the mountain people, you know they are the finest people on God's earth. You feel as if you were a minor, mining for gold. Occasionally you find some material that is valueless, but almost always you find nuggets of purest gold. It is that kind of work that is so tremendously interesting and gives a fine touch to our forestry work, if by any chance we can make that forest help in educating our boys.

Mr. Tyler: I don't think I have ever known anyone who ever heard of Berea College who was not interested in it.

Dr. Korstian: May I add a word or two to what has already been emphasized by some of the men preceding me.

I should like to stress the point mentioned by Mr. Frothingham, that in his judgment the Station cannot make the progress it should in the Coastal Plain until such time as it gets one or more experimental forests in that section of the country. The reasons, upon reflection, are perfectly obvious. Our experience at Duke has taught us also that one thing we need is information on land use and land classification.

Just the other day I was talking with a man from Wilson, N. C., who called my attention to the fact that farmers in that section of the State were burning coal to cure their tobacco, instead of using wood as was formerly the case.

I would like also to emphasize the point in connection with controlled burning. First of all we must recognize the inherent differences between longleaf and loblolly pine. Loblolly pine is quite a different species from longleaf. I agree with Mr. Chapman, in his comments about longleaf pine, but this does not apply to loblolly pine as I see it. We have had enough experience the last two fire seasons to convince us that loblolly pine, up to 12 inches in diameter, would be killed by fire in spite of some of our neighbors who tell us that they had no trouble at all. In that rather limited way, it seems it is the function of the Appalachian Station to carry forward that particular investigation with such cooperation as it can get from others in the territory. The first big thing the Station needs is an adequate number, say one to three, of experimental forests in the Coastal Plain, particularly in the loblolly pine section of the territory.

Mr. Tyler: If anyone thought, when I mentioned the matter of fire that I was talking about loblolly pine, I would like to correct this. I have seen enough loblolly pine to know that fire does kill it and I had in mind longleaf pine, which is much more a problem of the Southern Experiment Station than of the Appalachian Station. There is not enough longleaf pine in this section to duplicate the work being done by the Southern Experiment Station.

We now come to a different subject, the question of streamflow and erosion investigations. We would like to hear from Dr. Hursh.

Dr. Hursh: The streamflow and erosion study begun by the Station during the past year concerns a three-sided relationship of forest and other vegetative cover, streamflow, and erosion. A critical analysis of this relationship within the Southern Appalachian region leads to the establishment of two major considerations; first, the relation of forest or other vegetative cover to streamflow, erosion being of minor importance; second, the relation of agricultural land or land that has been once cleared for agriculture to erosion and streamflow, forests being of importance chiefly as a possible corrective vegetation.

I shall not attempt here to present a complete analysis of these two major considerations. However, I wish to mention one point by way of introduction to the studies that the Station is now undertaking. For either of the major considerations mentioned the problem that demands immediate attention is that of the function of forests and other vegetative cover in regulating or influencing the supply and disposition of meteorological water. When floods are of major importance, then the water that must be studied is that of superficial run-off, together with shallow storage, the two being referred to as storm flow.

Here the function of vegetative cover would be in regulating the absorption and percolation of water into the soil. When absorption and percolation conditions are such that water is stored in the soil, no matter what may be the amount or intensity of the rain, then there will be no storm flow and no flood danger.

When erosion is the major consideration, again it is the absorption and percolation into the soil that is of essential significance, because if there is no superficial flow or run-off, then there is no erosion.

When total yield of water is of first importance for any given watershed, the amount of water that can be stored in the ground is again a function of absorption and percolation into the soil. In the case of watershed yield the discharge of water from the ground as evaporation and transpiration is a problem of great importance in the vegetation and water relations.

In all of the subjects we have mentioned, floods, erosion, and watershed yield, absorption and percolation of water into the ground is first in line of importance. Hence a problem presents itself of what is the influence of vegetative cover on absorption and percolation of water into the soil. One possibility is in reducing the velocity of rain and its driving effect upon the soil, but more important probably is the maintenance of porosity of the upper soil horizons by governing the organic layers of the soil. This brings us to the investigations that the Station is now undertaking.

For our general conservation problem we must know what type of vegetative cover is most efficient in regulating the absorption and percolation of water into the soil. If these functions are controlled by the organic layers of the soil, as we believe they are, then we must study the organic layers of the soil. To date it may be said that for our mountain area no scientific study of the organic layers of the soil has ever been undertaken other than those the Station has made in connection with other projects. Now, however, as a part of our streamflow study, we are undertaking a taxonomic classification of the types of organic layers of the soil that obtain under different vegetative cover in the region. Also we are taking data that will determine the actual rate of absorption and percolation for any given soil profile.

Our method of procedure is to record the intensity of precipitation simultaneously with the run-off as storm flow. This is being carried out for the important vegetation types within the region. In order to study the intensity of precipitation at will, we shall carry out observations using artificial rain of different controlled intensities. In this way we can study the influence of rain of different intensities on the storm flow from the same soil at different times when the soil contains a different moisture content. From our data we may be able to compute the amount of storm flow from a given vegetation type by knowing the amount and intensity of precipitation and the original moisture content of the soil. We should be able to compute the amount of water that will be stored in the soil beyond the depth of storm flow.

As the study progresses the greater appears the probability of its practical usefulness. We hope by the end of the present season to obtain enough data to compare a number of common vegetation types in regulating porosity of the soil and consequently absorption and percolation of water into the soil.

Although our studies on porosity of the soil for a given vegetative cover are basic and fundamental to all streamflow and erosion problems, the investigation also considers the observation and compilation of many facts supplementary to the general problem. I mention only correction of erosion and improvement of vegetation type for watershed efficiency.

I should be glad to answer any particular questions on this subject in relation to our work but do not care to take up any more time at present, unless there is some particular thing someone would like to bring up.

Mr. Tyler: In regard to the subject of forest insect investigations, we had expected to have Dr. Craighead or Mr. St. George here today to say a word to us, but I am sorry to say that no one was able to come. Since there is no one to speak for forest entomology, we will have to skip that part of the program.

Mr. Frothingham: Mr. St. George was planning to be here but he has been unable to come until next week. Mr. Huckenpahler is here and will demonstrate some of the entomological work tomorrow at Bent Creek. I believe that in the absence of Mr. St. George we had better pass over this subject for the present, although it is a very important part of the work and has been carried on energetically and constructively.

Mr. Tyler: Is there anyone here to say anything on the subject of pathology?

Mr. Frothingham: Since the transfer of Dr. Nelson to our staff the subject of forest pathology has languished until the Office of Forest Pathology can take it up again. We are particularly fortunate to have Dr. Nelson on our staff in fire studies on account of his knowledge of the fungi which follow fire.

Mr. Tyler: May we now turn away from this subject and hear from Mr. Burleigh, the biologist at the Station.

Mr. Burleigh: As you probably know this work in forest biology was inaugurated in 1930. At that time there was no definite understanding of what the more important problems were, or of how such problems might be approached. For this reason at the start a detailed study was carried on of the distribution and life habits of the various birds and mammals in this section of the country. Biological research being largely a matter of life relationships, it was extremely important that we have a knowledge of food habits, and this was given consideration in the actual collection of specimens and the preservation of their stomach contents. Game management has, of a necessity, had to be given a minor part of the time. This work may be considered under three separate headings. The first pertains to deer studies. In this connection a week in November was spent in Virginia, in the Tidewater section of the State. Investigations concerned especially the sex ratios of deer and the question of whether does were in such excess over bucks that there should be an open season on them. Food habits were likewise studied. The report on that work can be found in a recent publication of the Virginia Game and Fish Commission.

The second phase of game management work was the introduction of beaver into Western North Carolina. When this idea was first conceived it seemed very simple. The beaver were to be liberated and they would stay where they were put. However, in the first place it was found that they could not be placed where it was originally intended, for the lakes on Bent Creek had been drained and probably would be dry throughout the winter. For this reason it was necessary to look around for another location and a lake on the Biltmore Estate was finally decided upon. Then another problem was encountered. When the request was first made for the beaver Washington was asked to send two females and one male. When they came it was found that all three were females. Eventually that was straightened out, two males being donated by the New York Game Commission to supplement the three females already on hand, then the beaver, when placed in the lake, began to roam. They went everywhere. No individual has ever had more desire to roam about than those beaver demonstrated. They went down the French Broad River, and they went up Bent Creek, and later returned to the French Broad. Finally they came back to the Biltmore Estate. Now there are two pair with young there and apparently they are well satisfied with present conditions. It is felt that beaver will be of decided interest in this country because of their decided influence on streamflow.

Another phase of game management, and possibly the most important, is that of the control of predatory mammals. The situation here is unfortunate in many respects. The State has a law against using steel traps so that foxes and other predatory mammals are very numerous. This is rather bad from the standpoint of game birds, which are becoming very scarce. Turkeys are few and far between and, as is self evident, quail hunting is nothing compared with what it formerly was in this part of the country. To determine the actual influence of predators on upland game birds, trapping has been carried on on the Bent Creek area in an effort to eliminate as many predators as possible and see the possible effect of this reduction in numbers. In one month this winter nine foxes were trapped on this one watershed. In this case the actual trapping was carried on by Mr. Barrett and Mr. Sims.

If this can be considered an indication of the number of foxes on these ridges, fewer and fewer game birds can be anticipated in future years.

Another phase of the work is that dealing with the life histories, distribution and food habits of the birds and animals in this region. This is really a basic study for the entire project. Activities were at first limited to Western North Carolina, but the area has gradually been broadened to include the Piedmont and coast regions of North Carolina and South Carolina, the larger part of Georgia, and the mountains of Virginia and West Virginia.

Still another phase of the work is the effect of forest fires on wild life. This past fall an area was found on Rocky Knob where such a study was made. At the start it was felt advisable to limit it to rodents that might affect reproduction on a burned-over area. The problem originally conceived was to see how soon rodents, eliminated from a given area after a fire, would come back.

The following is a brief summary of this specialized project as carried on to date:

Three quarter-acre sample plots have been laid out on an area burned over this past fall, lying on the upper slopes of Rocky Knob, approximately twelve miles northeast of Asheville. Three other quarter-acre plots were established as control plots on unburned sites approximating as closely as possible conditions that originally existed on the burned area. Three distinct types, representing characteristic forest land in this region, were selected for this study: one in open hardwoods recently logged and with the ground covered with slash; one in open hardwoods not cut over at all; and the last in hardwoods with an understory of laurel and rhododendron.

For the time being it was felt advisable to limit this project to its silvicultural aspects. Each plot has, therefore, been intensively trapped for rodents. After a severe fire (and the majority can be classed as such on these mountain slopes) reproduction is highly desirable to replace trees killed outright or badly injured and to eliminate any erosion and resulting interference with streamflow. Rodents may or may not affect materially such reproduction. Their importance as a factor in limiting this new growth depends on the number surviving a fire, their increase from the time the area has been burned over until the dispersal of seed in the fall, and their food habits throughout this period. This is the information that it is hoped will be obtained as the preliminary step in the study of the effect of fire on wild life on these mountain ridges.

There was a surprising abundance of rodents on these ridges. Trapping on Bent Creek had convinced me that mice were far less numerous than was generally supposed, but I realize now my statements will have to be modified considerably.

A point, however, to be considered here is the effect of the remarkably mild winter that has been experienced throughout the East. More than half the mice caught were immature, their actual ages varying so much as to indicate continuous breeding throughout all of this winter. A normal winter with relatively low temperatures and frequent snow falls would undoubtedly result in a complete cessation of breeding activities until spring. Adult females taken early in February held young that would have been born within a few days from that time that these adults were caught, showing again that breeding activities were encouraged by existing conditions. It is well known that rodents fluctuate considerably in numbers over a period of years, and it is entirely possible that mild winters may be one of the controlling factors in this increase. Further work will be necessary of course before any definite statements can be made; but the query raised is, I feel, of decided interest.

The actual number of mice caught varied from twenty-one on the open hardwood plot to fifteen on the hardwood plot having the undergrowth of laurel and rhododendron. If this is characteristic of present conditions on these mountain slopes it would give a maximum population of eighty-four mice to the acre, a figure entirely at variance with data previously secured.

In this connection, data should be secured in as much detail as possible relative to the average distance traveled by these mice in their nightly forays for food. Undoubtedly a certain percentage trapped on these sample plots wandered in from other areas, and my maximum figures are much larger than they should be; but more information is necessary before any allowance can be made. This is a phase of the work that I plan to concentrate on in the near future.

Equally surprising to me was the presence of rodents on the burned plots where both shelter and food were apparently practically eliminated. Seemingly, these mice survived the fire and remained there rather than hunt more favorable conditions, for there certainly were no inducements for a definite migration into this area. So severe was the fire that the humus was entirely destroyed, exposing the mineral soil; and the underbrush was likewise gone, affording no protection from predators. Nevertheless, on one plot eleven mice were caught, with indications, from traps that disappeared during the night, that the actual population was even larger. This would indicate that fire has little effect on rodents, and future work may possibly show considerable damage to reproduction from mice whose food supply under such conditions has been reduced to the minimum.

The above remarks are merely indicative of what the fire study has brought out to date. Detailed work in the future should be equally interesting, and may possibly have a decided bearing on silvicultural practice in the Southern Appalachians.

A few comments on the subject of food habits, an important part of this work, might not be out of place at this time. During the past two and one-half years over 2,000 stomachs have been accumulated. To date nothing has been done in the matter of analyzing these stomach contents. A decided handicap will be placed on all future efforts until more is known about the food habits of the mammals and birds of this region. There are so many that are nocturnal that the only successful method is to analyze carefully the contents of stomachs and that, of course, involves much detailed laboratory work. Actual data ought to be available relative to what this wild life is eating and how their food habits effect the forests, other game birds, etc.

It is therefore suggested to the committee that they include a resolution to the effect that in all biological work in the future at this and any other station, that it not be handicapped by the absence of a collaborator or a food habits man who can analyze the stomachs and in that way speed up the work.

Mr. Mattoon: I would like to back up what Mr. Burleigh has just said in regard to the analysis of stomachs. We had 40 or 50 deer lost on the Pisgah, the stomachs of which were to be examined. It took considerable time and money to get them for examination. It has been two years now since they were collected and to this day neither Mr. Burleigh nor I have any knowledge of what was in those stomachs. If in the future we could have someone here to render us that service in Asheville, it would certainly be a great help. We should have a man and a laboratory here for that work.

Mr. Tyler: We will now hear about the forest planting studies. Mr. Sims, may we hear from you?

Mr. Sims: The planting studies at the Station have been restricted in scope to testing the suitability of native and exotic species for planting in the region. Even with this restriction there is ample opportunity for work, but activity has been held down by lack of funds and the press of other work.

Prior to 1931 some 80 plantations of 100 trees each had been established at an elevation of about 5,500 feet in the spruce-fir type of the Black Mountains near Mount Mitchell. Seventeen species were set out, some in replicate using different ages and classes of stock. So far the native red spruce and southern balsam fir appear to be doing better than the other species, which are exotics. During 1931 two additional plots each of Sitka spruce and white spruce were planted in the high country. These plots are intended to check the results from the earlier plantings of the same species.

Plantings at the lower elevations, around 2,000 to 2,500 feet, have been practically confined to the Bent Creek Valley, where some 50 species have been planted, ranging from a few trees in the Arboretum to over an acre in some of the larger plantations. As was expected, success has varied widely. In the Arboretum, Scotch pine, red pine, Japanese red pine, and southern white cedar appear to be doing well, while Douglas fir, white fir, larch, and the spruces are the notable failures. Tomorrow there will be an opportunity to inspect some of these plantings.

In the spring of 1931 a plantation of Japanese red pine, a little over an acre in extent, was set out on the experimental forest. An inspection of the plantation early in March of this year indicated a survival of about 85 per cent with many thrifty plants. Severe freezing weather later in March, together with deer, rabbit, and insect damage have caused heavy mortality since then.

During the current year no additional planting is planned, and in the spruce-fir type none will likely be done in the future. Such time and money as is available for the project this year will be spent in examining existing plantings and preparing a progress memorandum.

Mr. Tyler: We would like to hear from Mr. Buell again on the subject of phenology at the Station. This is an entirely different line of work from what we have been hearing about.

Mr. Buell: Phenology is, of course, the study of the periodic changes in vegetation. In forestry we are concerned particularly with periodic and seasonal changes in forest trees; their budding, leafing, fruiting, and the casting of their leaves. We need as a substitute for our man-made calendar, a phenological calendar which takes into account the actual happenings in the woods. This type of calendar is needed for instance when we are to collect seed. If we had carried our records long enough to know something definite about the stage of vegetation at low altitudes at the time, for example, when spruce seed are ripe on top of Mount Mitchell, we would save ourselves a lot of expense and trouble. Furthermore the knowledge of the reactions of trees to weather, which phenology gives, is important in the study of tree physiology.

Getting down to the actual work on the project, it is given a separate place on the program merely because it does not fall logically into any other project of the Station. It is carried on almost altogether by the aid of cooperative observers. We have the same trouble Mr. Pierce does, in getting men to carry on the work for us without pay. So far we have been able to line up some 30 observers throughout our mountain and Coastal Plain region, where the project has been active for only two years.

The differences in tree activities in our territory within a single section are interesting but the important thing is to get long-time fluctuations for our whole territory. The importance of this work depends on its continuation. I feel the results are going to be much more important than we now realize.

Mr. Tylor: We have now reached the end of the reports of the Station as made by the men in charge of the projects. I want to take this opportunity to thank each one of these men for the interesting and concise reports they have given us.

This brings us to the matter of recapitulation of these reports. For the Station I will ask Mr. Frothingham to talk to us.

Mr. Frothingham: You have heard the discussions by the different members of the staff of the Station and the cooperators and have some idea from them of the way the different projects fit into the general picture of forest management. I don't think at this time it is necessary to recapitulate in the accepted sense. Instead of doing that I would like to tell you about some of the things we are not doing and some that we think we should be doing on a larger and more intensive scale.

I prepared a statement for our annual report outlining the desirable expansions of the Station's activities. It would be neither right nor practicable to suggest additional expenditures during this depression, and so the statement was not included in the report. The Resolutions Committee, however, may have other ideas, and it is certainly proper to indicate, even at this time, that there are other activities than those upon which we are engaged which should be undertaken when conditions improve so that it will be possible.

Among the lines of work which seem especially important but upon which the Station has not yet been able to do anything are:

(1) A forest survey of timberlands to determine and classify the area, the kind, value, and quality of the timber, the rate of cutting, etc. Such information would have an obvious value to industries and timberland owners, and would make it possible to formulate plans and policies for timberland management on a basis of concrete knowledge rather than conjecture.

(2) Studies in forest economics, to determine the economic feasibility of timberland management. Our present studies, as you know, are restricted to determine the silvicultural and protective practices that are appropriate for different classes of forest, with only incidental consideration of economic feasibility.

(3) Studies of forest management and protection on the Piedmont and other plateaus. We have thus far been limited to the mountain region, with the time of one man for Coastal Plain studies.

The activities that should receive substantial increases in facilities and personnel are:

n (1) Streamflow and erosion studies, for which only \$5,800 has been available, and that for only one year,

(2) Coastal Plain studies. We have been restricted in these to the time of only one man, who has had to limit himself to phases of the study of loblolly pine. Not only does loblolly pine merit a considerable expansion of work, but an increase of funds for determining the growth, reproduction, and best management of the ^{done} large and important coastal swamp forests, on which nothing has ^{been} done yet in this territory, is highly desirable.

(3) Planting studies, which have held a minor place so far. They should be expanded to provide the information necessary to prevent failures in the forest plantings that are increasing in volume from year to year.

(4) Growth studies. No money has as yet been provided specifically for such studies, and all that has been done has been incidental to other work, on an extremely inadequate basis.

(5) Forest fire weather research. This has barely been started, and it should be moderately expanded to fulfill its great possibilities for forest protection.

(6) Forest pathology. The vacancy left by the transfer of Dr. Nelson should be filled as soon as possible. There is need for the resumption of this work.

(7) Forest biology. As shown earlier by Mr. Burleigh there is urgent need for special work on food habits. Its lack is seriously interfering with the biological investigations now under way.

I want to bring before the Council a report prepared by the forestry committee of the Southeastern Council, and adopted at the Atlanta meeting, in March. The forestry committee, which is one of the fourteen or fifteen different committees of the Southeastern Council, prepared a ten-point report which was later condensed into a three-point program with three supplementary recommendations. It covers so well the forestry needs of this region that it would seem to me very worth while for the Council to show its support of this program by resolution, if it feels so disposed.

One thing that Colonel Pratt touched on this morning was the place for some agency which could carry on work of a more fundamental nature than this Station can; work which we cannot undertake, and which is of importance and would throw light on some of the work we are doing. The particular subject he mentioned is forest biology, and I want to say that the Station would welcome any such organization. We would hope to cooperate in its studies to the extent compatible with our own investigations, and I am sure that we would gain a good deal from such an institution.

Colonel Pratt: I would like to say a word on behalf of the Council. I have just been listening to Mr. Frothingham and I have intended saying, in my statement, almost exactly what he has been saying. I have just dictated, for the Resolutions Committee, to be passed by the Council, a set of resolutions which I think you will find very much along the line of what he has presented as to the needs of the Station. I have gone farther and brought out the amounts of money that seem requisite for the different investigations.

I think from the reports made by the different members of the Station that the members of the Council are in accord with the statement sent to the Station and Council by Mr. Robertson. We are pleased with the results of the investigations made so far. Those have been of such character and value that every member of the Council can say they approve of the work that has been done; it has been of great value to industry and to the owners of forest land in the Southern Appalachians.

One thing brought out in regard to fire protection is the effort to work out methods of fire damage appraisal. For a good many years in North Carolina we have been keeping track of forest fires and have tried to determine in some way the amount of damage done by these fires, but we have had no satisfactory means of determining what was the actual extent of the property loss and damage.

The statements we have heard have brought out the thought that forest management investigations should be conducted and continued in the Coastal Plain region, and that they should be brought back also into sections of the Piedmont surrounding the Appalachian mountains. We have one resolution requesting that the Station, as soon as possible, and without interfering with other research, allot a full-time investigator for continuing work in the Coastal Plain region.

Of course you must keep in mind that while we cannot and have not asked for increased appropriations at this time, I am putting in the costs of these investigations with the idea that as soon as conditions are right we should ask for those appropriations from Congress.

Another bit of research which is now going on, and the increase of which as soon as appropriations can be obtained will be of interest to all members of the Council, is the streamflow-erosion investigation. I want to say in this connection that we are considering having experiments made, not, perhaps by the Appalachian Station, as to the quality and character, as well as the amount, of water flowing in our mountain streams and as to the value of that water to certain industries.

I think the Council is in accord as to the need of a pathologist to be assigned to the Station to take up the work left off by Dr. Nelson. We will have a resolution to vote upon tomorrow to this effect.

I can say for all the members of the Council, that we are pleased with the work that has been done by the Station; and also the individual interest taken in the work of the Station by its members and the loyalty they have shown to the Director.

Mr. Tyler: We are sorry that it has been impossible for certain members of the Council, who are actually residents of Asheville, to be present today. We regret also that Mr. Woolford of Georgia, recently appointed member of this Council, cannot attend. Mr. Woolford sent the following telegram: "Even after I had my bag packed to come a situation arose which made it impossible for me to get away. Am so sorry not to be with you as I might learn so much. Wish you a successful meeting and extend personal regards." Likewise we regret the absence of Mr. Lufburrow. We want to record the fact that Mr. T. P. Cooper of Kentucky could not be with us today on account of business. We regret also that Mr. Cardwell cannot be here today. Mr. Hazard and Mr. Horn, both of Tennessee, could not attend, and Mr. Hummel of Virginia is unavoidably absent; I had a letter from him saying he had been summoned to a meeting of the Interstate Commerce Commission. Mr. Jones wired me on the 15th that he would be detained. Mr. Raino of West Virginia I have already spoken of.

We come now to the question of forest investigations by agencies other than the experiment station. I believe we had best leave this part of the program to be taken up tomorrow afternoon at the laboratory at Bent Creek. If there are no further remarks the meeting will stand adjourned until tomorrow morning when we will all start for the field promptly at 8 a.m.

The meeting adjourned 4:38 p.m.

June 18.

After a morning field trip to inspect experiments on the Bent Creek experimental forest, the Council reassembled in one of the Bent Creek field laboratories and the meeting was called to order at 1:30 p.m., by President Tyler.

Mr. Tyler: We have one section left over from last evening, relating to investigations by other agencies than the Experiment Station. We have two state foresters present. Mr. Smith, will you tell of your work in South Carolina?

Mr. Smith: To make a very brief statement, we have, in South Carolina, 500,000 acres under protection, with 6 steel towers, two of which are on the South Carolina line overlooking North Carolina. Cooperation is received from the North Carolina Forest Service. Educational work, as I have previously stated at more length, is conducted through the Smith-Hughes Schools, one of which is located in each county. These schools have 10-acre demonstration forests on which fire lines are built and thinning and improvement cuttings are conducted.

Mr. Tyler: We will now hear from Mr. Holmes:

Mr. Holmes: I am speaking in behalf of the North Carolina State organization. We are very much interested in the investigative subject of fire as related to soil erosion and the amount of humus remaining on the ground.

The white pine blister rust may invade our territory at any time and all persons interested in Southern Appalachian forests should be on the lookout for the appearance of this disease, which may be controlled by the eradication of gooseberry and currant bushes. These should be eradicated around all nurseries.

The research which Mr. Claridge is carrying on in nurseries and plantations is as follows:

"Grub control in the nursery. In cooperation with the Bureau of Entomology, Dr. Craighead and Mr. R. A. St. George, Associate Entomologist, we have inaugurated some experiments to control the white grub infestation in the nursery near Clayton. Last year this damage was very serious in the seed beds and on an actual count of 2,027 square feet, dug to get rid of the grubs, 2,116 grubs were secured. This shows an average of over one grub per square foot on this heavily infested area. The Bureau of Entomology advised trying experiments with acid lead arsenate. This was applied to seed beds in the proportions of 2 pounds to the hundred square feet, 3 pounds to the hundred square feet, 4 pounds to the hundred square feet, and 10 pounds to the hundred square feet. This chemical was mixed in the soil at the time of sowing the seed. Check beds were made adjoining all these treatments and the treatment was applied to shortleaf,

slash, and longleaf pines. From recent observations the grub damage in the treated beds seems to be much less than in the untreated beds. However, it is too early yet to make any definite predictions as to the effect on the seedlings and efficiency in controlling the grubs.

"In the untreated beds not concerned in the above experiment during the last few days the grubs have been very active. Therefore, we are trying the treatment with carbon bisulphide emulsion. This comes in a concentrated form and is diluted in water and the beds either flooded or sprayed with this mixture. It is hoped that this treatment will kill the grubs now actively working in the rest of the beds. The formula for application was supplied by Mr. R. A. St. George of the Bureau of Entomology.

"Slash pine questionnaire. Due to the increased interest in the planting of slash pine in North Carolina, it was decided to circularize the cooperators of previous years and find the results from their plantations; also to make a brief study of our own plantations of slash pine. The general results of this questionnaire seem to show that for some reason either in planting practice or climatic conditions in the majority of cases the slash pine does not survive as well as loblolly pine in Piedmont and Eastern North Carolina. However, the rather small number of plantations established makes it difficult to give this as a general rule. The results from the Duke plantation, upon which a very careful count was made is below.

	No. counted	Alive trees		Vigorous trees		Weak trees	
		No.	%	No.	%	No.	%
Slash pine	566	367	64.8	274	48.4	93	16.4
Loblolly pine	652	605	92.8	525	80.5	80	12.3

The slash pine seems to make a more irregular growth in height than loblolly pine planted on the same site. The individuals of slash vary considerably in height while loblolly pine on the same site shows more regular growth and a higher average height growth.

"Continuation of the Asiatic chestnut plantations. Three additional Asiatic plantings were made this last season. The one at Duke Forest was added to with 1,464 trees. There was also a plantation of 300 trees made near Rocky Mount, and 100 trees by a private individual at Brevard. The U. S. Bureau of Plant Industry has not yet issued any findings on their survey of last season on the previous plantations. There seems to be a tendency for winter damage of the young trees in the State nursery and a canker has developed on some of the trees which will be a factor in their production on a large scale."

Mr. Tyler: We would now like to hear from Dr. Korstian regarding the work at Duke University.

Dr. Korstian: I appreciate this opportunity to tell you of the work done at Duke since the last meeting of the Council. Duke Forest comprises about 4,300 acres to be used as a demonstration and experimental forest, where ultimately field work in silviculture can be carried on by forestry students as part of their graduate work. This past year the field work on an inventory of the forest has been completed and the mapping and office work are also almost done. This will give us the basis for our working plan. In cutting our budget we can be sure that we are not over-cutting our growing stock. All receipts from the forest - products or land use - will be devoted to the development of the forest and to research.

During the past year work has been carried on along the following lines: (1) A study has been carried on by Pavek and myself on the water relations of forest trees, with special reference to the physical and chemical properties of sap in relation to cold and drought. Cold and drought resistance appear to be related. (2) Mr. Coile has been carrying on a study of soil reactions, particularly soil acidity, in relation to the distribution of trees and types. Humus and decomposing soil layers are more acid than the underlying layers. Red cedar litter is not so acid. (3) A study of the physical and mechanical properties of our commoner soils will be necessary for the first report of the forest.

Next year will mark the beginning of instructional work in forestry. This fall freshmen in Trinity College will be admitted to a pre-forestry course, with botany, physiology, and other related subjects, and just enough forestry to arouse interest in the subject. Graduate work in forestry will be available to students in 1935.

It is very gratifying to note the interest in forestry taken by other departments of the University. Dr. Blomquist, of the Department of Botany, is developing a herbarium and will get out a flora of the forest, probably including tree species. Dr. Cramer of the Biology Department is conducting a study of water relations of plants, using tree species, yellow poplar, loblolly pine, etc. Dr. Pearse, head of the Department of Biology and Professor of Zoology, has started a study of the fauna of forest soil, including the overlying litter layer. He expects to have graduate students working with him.

An agreement has been made with the State for the establishment of a game refuge on the forest. Some work will be done in game propagation, in addition to the conservation of ring-necked pheasants and other game now on the forest.

In cooperation with Messrs. Holmes and Claridge, year before last we planted 42 acres to quite a number of species at \$5.90 per acre. This year 125 acres were planted at a cost of \$4.69 per acre, including stock, with 25¢ per hour for labor. Of the first year's planting of loblolly 92 per cent survived. Slash pine was less successful. This year we made mixed plantations by rows and in checkerboard fashion, the latter method being more expensive. We are in the belt where loblolly pine, although just on the edge of its range, does well on fairly good sites.

Mr. Tyler: Any questions?

Mr. Frothingham: Does Dr. Korstian anticipate doing any work outside of Duke?

Dr. Korstian: I take the position that we have all that we can do to put our own house in order. The forest is teeming with problems and I think that members of our staff should devote their entire time to the forest proper and the immediate vicinity. It will be some time before we are ready to go elsewhere. We have had overtures from people in the western end of the State asking for a demonstration forest. I appreciate their arguments, but I believe that we shall be overlooking wonderful opportunities if we do not work at home. Later on it may be desirable to have another man working on soils problems, possibly in cooperation with Dr. Hursh.

Mr. Tyler: We should like to hear from Mr. Mattoon.

Mr. Mattoon: I have enjoyed it all immensely, particularly as the Pisgah National Forest plays host to much of the Station's work. The two organizations work closely together.

Mr. Tyler: I want the members of the Pisgah staff to understand that they are always welcome to our meetings.

Mr. Tyler: We will now have reports of committees. First I suggest that a motion be made thanking the ladies for the delicious lunch.

This motion was made and carried.

Mr. Tyler: We will now have the report of the Resolutions Committee.

Mr. Clagett: (Here Mr. Clagett read the resolutions, each of which was voted on and passed by the Council. The resolutions are appended to those minutes).

Mr. Tyler: The report of the Auditing Committee is now in order.

Mr. Smith: The Auditing Committee finds that at the time of the last audit (June 2, 1931) the treasurer's records showed a balance of \$2.42. This was augmented by contributions, in 1931, of \$2 apiece by eleven members, giving total resources of \$24.42. Against this are disbursements of \$4.97 in 1931, and \$2.78 in 1932, or a total of \$7.75, giving a present balance of \$16.67. The treasurer's record seems correct and is approved.

The report of the Auditing Committee was adopted.

Mr. Tyler: The Nominating Committee will present its report.

Dr. Burruss: Mr. President, this committee has been very hard worked. There appear to be no candidates, so we recommend that the present incumbents be drafted. I so move.

Officers reelected: Mr. Tyler, President, Colonel Pratt, Chairman of the Executive Committee, Mr. Frothingham, Secretary.

Adjournment

E. H. Frothingham,
Secretary.

E. M. Pearson

J. H. Buell

Secretaries pro tem.

RESOLUTIONS

ADOPTED AT THE EIGHTH MEETING OF THE APPALACHIAN FOREST RESEARCH COUNCIL
Asheville, N. C., June 18, 1932.

I. Research Activities Recommended by the Council: While the expansion of the Station's work at the present time is, of course, not urged, the Council feels that there are several important lines of research work that the Station should take up just as soon as additional appropriations can be obtained. The Council feels that the need for this research is self-evident and therefore only brief statements are given herewith regarding these various subjects, including:

Forest Survey: There is no specific and reliable information as to the areas of the different classes of timberland in the Southern Appalachian region; the kind, quantity, and quality of the timber; the rate at which it is being cut; and other related subjects. Such information is indispensable for all forestry activities. There should be available at least \$20,000 to start this investigation.

Streamflow and Erosion Studies: The Council has recommended that an annual appropriation of \$30,000 be provided for this purpose. For the fiscal year beginning July 1, 1931, the Station has only \$5,500 to work with. This amount is altogether inadequate except for preliminary studies on a small scale. The Council believes that if properly carried out on a scale commensurate with their importance, such studies will require an annual allotment of at least \$30,000.

Forest economics: It is extremely important for the development of Southern Appalachian timberlands that the economic feasibility of their management be worked out. Studies of the financial aspects of timber growing, generally similar to that now under way at the Southern Forest Experiment Station, would be of great benefit to the Appalachian region and would round out the present program of the Appalachian Station. There should be available for this work at least \$15,000.

Coastal plain studies: The importance of the Coastal Plain forests warrants an increase of the small-scale investigations now under way which are confined to the pine forests. No work at all is being done in the large areas of coastal swamp, and there is no reliable information as to its growth rate, reproduction, protection, or best management. In view of these considerations the Council recommends the assignment of one full-time man, or the equivalent thereof, to Coastal Plain work as soon as other work can be re-arranged to permit it. We feel that this work is so important and needed that the Director is urged to make every endeavor to so re-arrange the work of the Station that a full time investigator can be detailed at a very early date for this work.

Forest Management on the Piedmont and Other Plateaus: No funds have yet been given to the Station for work on the Piedmont and other plateaus, where farm woodlands aggregate over 20,000,000 acres. Their location near numerous and varied markets gives them unusual advantages for management. The possibility of making sub-marginal agricultural lands profitable by timber production ties in with an urgent problem of land use. The Council therefore believes that extension of the Station's work to the agricultural plateaus should be provided. This would require approximately the full time of one man.

Planting Studies: There is a particularly urgent need at present for forest planting in the rehabilitation of forest lands in all parts of the Station's territory, and it should be provided for in the Station's program by funds estimated at \$10,000 or \$12,000.

Growth Studies: This is one of the most important of all the subjects that are in need of investigation, but as yet the Station has received no allotment for it. It will require from \$5,000 to \$10,000 to adequately begin this investigation.

Forest Fire Weather Research: It is foreseen that this study can be made extremely valuable and funds for its continuation by the Weather Bureau and also to the extent necessary by the Appalachian Station, should be granted. The Council is very much gratified by the appointment of Mr. L. T. Pierce for duty at the Station.

Forest Pathology: The transfer of R. M. Nelson from the Bureau of Plant Industry to the regular staff of the Appalachian Station as silviculturist has caused a suspension of the work in forest pathology, as no one was appointed to take his place as pathologist. The appointment of a successor to Dr. Nelson was impossible under limitations of expenditures set up during the present emergency. The need for the continuation of pathological investigations is urgent and the Council urges the Bureau of Plant Industry to appoint a pathologist to the Station at the earliest date possible.

Forest Biology: The greatest need in these studies at the present time is for the development of food habits research, which lies at the root of several major investigations under this head. This was fully recognized by the Biological Survey, which proposed to place an investigator of food habits at the Appalachian Station last year. Although these plans have had to be deferred for the present, it is most important that such a man be attached to the Station just as soon as it can be done.

II. Need of a Forest Research Institute: The Appalachian Forest Research Council desires to emphasize the need in the Southern Appalachian region for coordinated research in all phases of forest life and the factors affecting it, including, besides trees, the herbaceous and shrubby vegetation, fungi, bacteria, insects, wild animal life, soils, organisms in soils, and rock formations.

The conduct of the more fundamental research in forest biology can probably best be centered in an endowed institute of forest biology. The creation of such an institute would supplement the researches of the Appalachian Forest Experiment Station and co-operating bureaus of the U. S. Department of Agriculture. Such forest research institutes have been recommended by a committee of the Society of American Foresters and by Dr. I. W. Bailey and Dr. H. A. Speehr in "The Role of Research in the Development of Forestry in North America." The Council believes that the establishment of a fully equipped and adequately financed research institute of forest biology will greatly advance forestry in the South, and that such an institute would receive the hearty co-operation of the United States Forest Service, the several State Forest Services, forestry and biological associations, and foresters and biologists generally.

III. Endorsement of Forestry Activities by the Southeastern Council, Association of Southern Agricultural Workers, and Southern Forestry Congress: WHEREAS, a knowledge of forestry and its objectives, leading to its more general study and practice, can only be secured through interested individuals and organizations;

THEREFORE, Be it Resolved: That the Council heartily endorses in principle the recently formulated policy of the Forestry Committee of the Southeastern Council and welcomes and appreciates its support:

Resolved further, that the appointment of a Forestry Committee by the Association of Southern Agricultural Workers is approved and welcomed as an added agency for progress in this field; and

Resolved further, that the early return of the Southern Forestry Congress to active participation in forestry publicity and influence, carrying out the ideals of its founders and supporters, promises aid at a time when such help is greatly needed.

IV. W. R. Hine. The Council has learned with a great deal of satisfaction of the continued improvement of W. R. Hine, and sends to him its sincerest congratulations and best wishes for his early restoration to complete health.

V. Work of the Appalachian Station: The Council has observed with keen appreciation the expansion of the work at the Bent Creek Laboratory and takes a great deal of pleasure in extending to Director Frothingham and his associates its grateful appreciation of the thoroughness of their work in the field, at the laboratory, and in the office; and wishes further to commend them all for their loyalty, enthusiasm and personal interest in the work of the Station.